WOMEN ACADEMIC SCIENTISTS: A STUDY OF SOCIAL AND WORK ENVIRONMENT OF WOMEN ACADEMIC SCIENTISTS AT INSTITUTES OF HIGHER LEARNING IN SCIENCE AND TECHNOLOGY IN INDIA

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by

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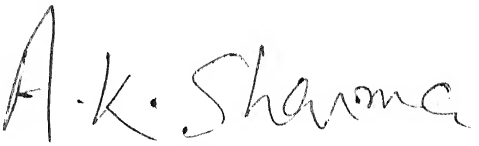
CERTIFICATE

It is certified that the work contained in the thesis entitled *Women Academic Scientists: A study of Social and Work Environment of Women Academic Scientists at Institues of Higher Learning in Science and Technology in India* by **Namrata Gupta**, has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.



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To my husband

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SYNOPSIS

Indian women are relatively new entrants in the field of science and engineering. Despite considerable increase in the enrolment of women in higher education, their share in science and engineering education is still quite low. In particular, their representation as faculty members involved in teaching and research is less than one-twelfth in the best institutes of higher education in science and engineering. Yet, despite their small number, these women. in science and engineering represent the growing pool of women intelligentsia. Their problems need to be highlighted and analysed so that an effort can be made to solve them, and women academic scientists are able to contribute to their fullest. Such a study might also bring to light different aspects of the profession, which have not been recognised so far.

Science, and especially technical knowledge, is considered a man's enterprise, and stereotypes in some areas of science are quite strong. In this context, the present study aims to examine the social and work environment of women academic scientists. It attempts to reveal the experiences and problems faced by them in science and engineering institutes, which are dominated by men. This study also studies the effect of patriarchal social norms and social stereotypes that are reflected at all levels of society including the workplace.

There is a paucity of literature on women in science in India and none has been done on the premier institutes of north India. After surveying the relevant literature in the sociology of professions, sociology of science and gender studies, I have presented a conceptual framework for studying the problem, which combines the concepts drawn from these three sub-areas of sociology.

In the Mertonian tradition, sociologists have considered science as a universalistic profession where all are treated equally, and in which rewards are based on merit. Rejecting this position, many post-Mertonian sociologists have stressed the particularistic aspects of role performance of scientists. These sociologists revealed the role of contacts and networks in building a successful career. These particularistic aspects in science have some unique implications for women. Particularism in science has been related to the formal and informal aspects of the profession of science, and the indeterminate elements

involved in it. Formal aspects of the profession refer to the rule governed aspects of the organisation dynamics and profession, such as appointments, promotions, assignment of research scholar and obtaining funds. But there is indeterminacy in these formal aspects. These indeterminate elements include stereotypes, contacts, and networking. Importance of informal contacts and participation of women academic scientists in informal activities are studied to understand the nature of issues faced by them. Moreover, a woman academic scientist is not only a part of the scientific and academic community: she also operates in a particular social context. The definition of the roles of men and women and the extent of their rigidity have important implications for gender relations both in the workplace and the family. Thus, women in scientific profession can be seen as victims of patrifocal values present in the larger society.

To study the problems faced by women in academic science, four elite academic institutes from north India were chosen. They are Indian Institute of Technology (IIT) Kharagpur, IIT Delhi, University of Roorkee, and Jadavpur University. These institutes are known for their excellence in academic science and for giving due recognition to merit and talent. Since women faculty in science and engineering are very few in number, all women faculty involved in teaching and research in science and technology in these institutes were selected for the study. Faculty members in biological and medical sciences are not included in the study. All respondents, except four, have a Ph.D. degree. Data are collected using triangulation, that is, a combination of questionnaires, interviews and unobtrusive methods. The main findings of the thesis include an analysis of the social and professional milieu of the respondents, the formal and informal environment of work, and the impact of the social and work environment on them.

The analysis of social milieu includes social class and family background, education of parents and siblings, the nature of family support for higher education, and the presence or absence of role models among relatives. The data on marital status and marriage show that the norms regarding age and educational differences between spouses are changing. However, stereotypes about women's education in science persist. This is shown through their perceptions and experiences. The professional profile of the respondents is analysed to learn about their professional achievements. The thesis also

deals with the environment of academic science in India, and women scientists' perceptions of the research environment in the country.

An examination of the formal structure of work organisations shows the status of women academic scientists in the hierarchy. They constitute only 7% of the total faculty in science and technology. Very few are at the level of professor. Being in minority and junior positions affects the formal aspects of work. Appointments and promotions of faculty are made according to rules (merit). Yet a high percentage of women faculty reported that there is a 'subtle' or 'covert' discrimination against women candidates. Even those who reported that there is no bias against women, said that a woman's bio-data has to be 'really good' or 'women have to prove themselves'. Women were not appointed as faculty in civil and mechanical engineering as a matter of principle till the early 1990s in some institutes. At two places women are still not preferred in the mechanical engineering department. Women academicians face problems in getting research scholars, and funds for research projects and international seminars. Women faculty members are seen by students to be having fewer contacts and less time for academics. In addition, political factors (marginal position of women faculty in administration), head of departments indulging in favouritism, and gender bias reflect subtle discrimination. Sometimes the funding agencies want to verify whether a woman can do the fieldwork. Of course, there are also some agencies that encourage women faculty by funding their work.

Data show that women faculty members spend more time on teaching than on research. Unfortunately, teaching brings no tangible rewards. And in their overall performance as academic scientists, their achievements seem to be underestimated. Women are almost invisible at the higher echelons of administration. Appointments on committees are perceived to be largely political. The system's insensitivity towards gender is brought out in the lack of various structural and supportive facilities available for women faculty members.

My analysis of the informal environment links the implications of lack of critical mass to the concept of 'tokenism'. Tokenism involves three types of reactions that occur simultaneously. First, women as tokens are more noticed for blunders, atypical behaviours, etc. Their clothing, speech and behaviour become the subject of review by

the majority (i.e., the males). Second, they are typically isolated and left out of informal socialisation process. Third, women are often cast into stereotypes such as mother, or sister, which implies condescending behaviour.

The majority of the respondents in this study believe that success in scientific research is not always in proportion to merit. Contacts outside the organisation and informal networks with other scientists are very essential to success. Contacts provide information about new research data, projects, and collaborations, and through them placement for students becomes easier. Women scientists are not generally very active in maintaining contacts and informal networks. They usually travel less than men scientists do. Thus their participation in seminars and conferences is lower than among men. Women scientists lack contacts within the institute also, though they understand that informal contacts help in providing information and career advancement. Due to time constraints, token situations, and norms of segregation, women cannot interact freely with men colleagues or sit with them in the evenings, chat or drink, when names for various committees may be decided.

Science and engineering institutes, like any other organisation, have informal groups but women scientists usually do not form part of such groups. Membership in informal groups is of great consequence to career. Groups influence decisions in the department. In organised informal activities also (such as, activities of the faculty club, cultural associations, and social service programmes) women's participation is lower than that of their male counterparts. This implies fewer interactions, fewer contacts and less visibility. Less visibility means less recognition for one's work and less chance of being in powerful positions.

Underestimation of performance, a general belief in the intellectual inferiority of women, lack of informal contacts and networking, and a lack of institutional and social support contribute to a gendered work environment. This has important consequences: in order to prove themselves, women scientists have to work much harder than men, are quite isolated in their work environment, are expected to behave like 'women' (i.e., their colleagues expect them to be submissive). This leads to stress. In addition, having family responsibility creates a dual burden. As a result, women scientists often suffer from a

triple burden: the double burden of work and family, and the stress originating from the gendered environment of work.

Virtually all the respondents in this study said that there is an effect of marriage on career, and about half of them say that motherhood leads to decline in scientific productivity. However, almost all believe in the importance of marriage and family life. Thus, women have two strong values of family and work. The conflict between these values can often be source of frustration. There are several impacts of career stress and dual burden on women scientists: compromises in career progression, lowering success goals, exhaustion, identity crisis and social isolation. Faced with stress, some women give primacy to family roles. This prevents them from making full use of career opportunities that come their way. Most women feel exhausted (more physically than mentally). A majority of the respondents said that they would have been better placed in career if they were males. A majority believes that they are unable to utilise their potential fully. Women scientists face conflict of identity and a general isolation within and outside the workplace.

On the whole, I develop a holistic picture of the environment in which women scientists work. My research shows the importance of the concepts of indeterminacy and tokenism and lends a general support for feminist theory. This study shows that woman scientists experience gender-related stress in the profession besides the much talked about double burden. This stress arises from the social and work environment and hampers women's contributions to their profession. Finally, I discuss the limitations of the thesis and suggest topics for future research.

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Worldwide, women in science and engineering have been a rarity. India is no exception. It is only recently, that women in India have begun to enter the scientific profession. The proportion of women enrolled in the faculties of science is only one-third and those enrolled in the engineering faculties is less than one-twelfth (Chanana, 2000). In particular, women scientists and engineers employed as faculty members in higher education institutes are very few. The present study focuses on the environment in which the women academic scientists work and the problems they face in the institutes of higher learning in science and engineering that are dominated by men.

Science is believed to be associated with meritocracy and its standards are considered universalistic. Having proven their talent, women academic scientists should be in a position to contribute to science to their fullest. Whether they are actually able to do so, however, depends to a large extent on the environment in which they practise science. In this sense it is important to have knowledge of the issues that women face. Such information will also enable us to work out strategies to cope with the situation.

1.1 Statement of the Problem

Scientists and engineers employed in reputed academic institutes are involved in teaching as well as research. Women have been late entrants not only in science and engineering education but also in teaching in these institutes. The

ratio of women to men among teaching faculty in these institutes is extremely low. This study describes the experiences of women academic scientists, explores if the conditions under which they work are similar to those of men faculty members and examines whether they are able to utilise their potential to the utmost.

The social values and norms influence all aspects of society including education and science. Patrifocality is an important part of our value system. 'Patrifocality' refers to a set of predominant kinship and family structures and beliefs that give precedence to men over women. These male-oriented structures and beliefs constitute a socio-cultural complex that affects women's lives deeply, including their access to education and educational achievement (Mukhopadhyay and Seymour, 1994). The effect of patrifocal beliefs on women academic scientists would reveal the prejudices operating against women in the working of the scientific institutions. Moreover, the institutional and organisational aspects need to be studied from the perspective of women scientists so that their problems could be highlighted and solutions found. In this context, this study aims to explore the work environment of the women scientists in some of the elite academic institutions of India.

The profession of science is known for its fairness and equality in recognition and reward system. However, women scientists doing research in the Indian universities and institutes face problems common to the Third World scientists. In addition they face some specific problems also as the research environment involves issues and standards set by men. This study aims at understanding such general and specific issues affecting women scientists.

1.2 Rationale of the Study

My interest in the topic, lack of information in this area, and the inadequacies of the existing frameworks in studies of women scientists motivated me to take up this study. No study has been done on women academic scientists in the premier institutes of science and engineering. A framework of study, based on the literature survey, has been developed to study their problems

1.3 Women Education in Science and Engineering in India

Women's education in science and engineering in India is a recent phenomenon. The participation of women continues to be rather low in education in general and in higher education in particular. The roots of their underrepresentation lie in Indian history. Exclusion of women from formal education has been a long-standing tradition in India. A few learned women scholars, such as Gargi, did emerge in the early Vedic period (2000-1500 BC). Subsequently there was a steep decline in women's education that led the lawgiver, Manu, to declare in 200 BC that women along with untouchables are unfit for learning. Except for a few women of royal and elite Brahmin families, formal education of women remained poor. The British in their surveys of indigenous education in 1820s and 1830s in India found a total absence of girls from traditional village schools and from higher learning. These surveys also reported deep prejudices against women's education (Basu, 1999).

It was the Christian missionaries, followed by British liberal officials and non-officials, who started schools for girls. After the 1850s, increased state interest in higher education, the rise of social reform movements, and

subsequently the women's movement led to an increased enrolment of girls in schools and colleges. Kadambini Ganguly and Chandramukhi Basu from Calcutta and Cornelia Sorabji from Bombay were the first women to graduate in the early 1880s. Progress towards higher education among women remained slow. As late as 1901, only 169 girls were enrolled in India's colleges. As a matter of fact, only 10% girls of school going age were enrolled in schools in British India (Basu, 1999).

The post-independence period witnessed a rapid enrolment of men and women in all disciplines. Increase in proportion of women in higher education has been remarkable. The proportion of women to total enrolment in higher education was as low as 10.9% in 1950-51. In 1991-92 it rose to 32%. In 1950-51 women's proportion to total enrolment in research was only 14.1%. This rose to 36.4% in 1993-94 (Chanana, 2000). However, as the figures indicate, women's representation in higher education is still only about one-third of the total.

Science and engineering, considered as male vocation, have been traditionally dominated by men. Discipline-wise ratios indicate severe underrepresentation of women in scientific and engineering disciplines. Twenty-four years after independence, in 1971, the enrolment of women in the undergraduate courses in engineering and technology was extremely low (0.09%). During 1971-81 it rose marginally to 0.42%. The following decade, however, saw a significant improvement in women's participation in science and engineering courses and in 1991, their share in undergraduate courses rose to 10.09%. In some colleges of some states like Tamil Nadu, this proportion has risen to 30% in some specialisations (Chanana, 2000). Proportion of women to total enrolment in pure

science subjects in colleges and universities increased from 7.1% in 1950-51 to 34.17% in 1996-97. The reduced importance of pure sciences for jobs has brought down their demand from young men. Thus, women are able to fill in these seats (Chanana, 2001). At present the highest proportion of women to total enrolment is in the discipline of education (52%), followed by arts (43.22%), medicine (34.56%), science (34.17%), commerce (23.14%), law (11.32%), engineering/technology (7.84%), veterinary science (7.79%), agriculture (7.09%) and others (38.90) (Chanana, 2000).

There is a tendency for women to cluster in disciplines that do not lead to specialisation and professional occupation. Among women, 54.2% joined arts in 1993-94 compared to the men students among whom 35.4% joined arts. In recent years shift in discipline choice is also visible as more women are entering in commerce, law, engineering, and agriculture and veterinary science. At the institutional level, more women are found in colleges of general education than in professional colleges. Thus, in the Indian Institutes of Technology (IITs) and regional engineering colleges there are very few women students (Parikh and Sukhatme, 1992). Here electronics is the most preferred specialisation by women, followed by electrical, civil, computer science, chemical, and mechanical engineering in that order.

1.4 Women in Science and Engineering Professions

In the teaching profession, the higher the level of education, the fewer is the number of women teachers. While their proportion is 52% in departments of teacher education which train secondary school teachers, only 35% of those in teaching profession at the secondary level are women. Their proportion in

affiliated colleges is 21%. In university teaching departments and constituent colleges of university their proportion falls to 11.6% (Chanana, 2000). In elite professional institutions women's representation falls further. Abbas in 1980 reported that the five IITs employed 1,766 persons in their faculty, of which only 58 (3.28%) were women. Indian Institute of Science, Bangalore had only 4% women in faculty (Abbas, in Jaiswal, 1993).

Partly due to lower enrolment of girls in science and engineering and partly due to various social and structural factors, the participation of women in science and engineering professions as such has been nominal. Around 1978-79, 2.77% women were employed in the public sector, 5.7% in the private sector science and allied occupations (Jaiswal, 1993). 'Research and Development statistics' published by Department of Science and Technology indicate that in 1980-81, out of 1.84 lakh personnel employed in Research and Development organisations, only 6% were women, half of whom were employed in administrative jobs and only one-fourth were in actual research and development activities. In terms of educational qualifications only 19% women in these organisations were engineers (with graduation or diploma in engineering) and more than half were from natural sciences (Jaiswal, 1993).

Thus figures indicate a low representation of women in science and engineering in education and other professions. The representation of women in the engineering profession and as faculty members in elite institutions of science and engineering is also extremely low. Women's low participation is a product of several social, cultural and structural factors. Some of these factors include gendered organisational structures and lack of facilities (such as common rooms,

toilets, hostels, and absence of counselling, non-availability of discipline of their choice, lack of role models, and indifferent or unfavourable attitude of teachers and administrators). Biased values and actions of parents and the perceptions of the relatives and peer group also affect women's situation in science adversely.

1.5 Review of Literature

The topic 'women in academic science' combines different areas of sociology. It links the sociology of science, the sociology of professions, the sociology of higher education and women's studies. Some findings from the literature in these areas are relevant for our purpose and are discussed below. This discussion is followed by specific studies on women in science and engineering in the West and in India.

1.5.1 Perspectives in sociology of science and their relevance in the study

There are three major frameworks in the sociology of science proposed by Merton, Kuhn and Knorr. Merton focused on the institution of science and suggested that scientific enquiry is governed by four norms of science -- universalism, communism, disinterestedness, and organised scepticism. Universalism implies irrelevance of particularistic qualities of race, nation, religion, class, and personal qualifications for acceptance or rejection of a scientific claim; it also requires that a scientist be fairly rewarded for his contribution to scientific knowledge. Communism means that the findings of science are a product of social collaboration and may be assigned to the community. Disinterestedness implies passion for knowledge, idle curiosity, and altruistic concern with the benefit to the humanity. Organised scepticism is the

absence of prejudgement of facts and a detached, logical scrutiny of facts (Merton, 1942). For Mertonians, the contribution of scientists mainly in the form of publications, research productivity and recognition in terms of citations and rewards, constitute the main issues of inquiry. There is a persistent debate on whether or not the scientific community indeed adheres to the Mertonian ethos. Subsequent frameworks and recent researches have pointed out that science is not as universalistic as Merton claimed, rather scientific norms often show varieties of particularism.

Kuhn's notion of a 'scientific community' refers to the idea of a 'paradigm' which scientists working in a given context subscribe to. Broadly, a paradigm includes theory, craft skills, model solutions, problems, or standards. Allegiance to a program delineates bounds a community of specialists (Jacobs, 1987). These communities are autonomous and homogeneous entities. Knowledge claims are made and evaluated within the community of scientists who have undergone similar training and follow the standards and techniques of the same paradigm. While Merton sees scientific rewards as a product of effective functioning of scientific norms, Kuhn suggests that the purpose of rewards is to promote allegiance to the prevailing procedures and ideas. He delineates the boundaries of scientific communities that enable a detailed investigation of communication and social relations within these communities. Citations are considered an effective instrument for understanding communication networks.

Scientists who followed Kuhn, such as Mulkay, Gilbert and Woolgar (1975) suggest that scientists who formed networks may belong to different disciplines and specialities. Thus, they may not share the same training, as Kuhn supposes.

Further, these networks may be smaller than communities and are more flexible and dynamic.

The third perspective, offered by Knorr and her associates is more philosophical. Advocates of this perspective favour detailed ethnographic studies of scientific work and practice. They try to demonstrate the presence of diversity, incoherence, and contradictions in the practice of science. Knorr (1981), in her study of an American research laboratory, emphasises the technical culture of each research locale. Scientific research involves 'selections' from the available techniques, equipment, and materials, according to locally recognised standards. Also in the process of research, scientists come in contact with people outside their research area, such as bureaucrats and university administrators, who influence their selection. Thus, in addition to the diversity of cognitive technical culture, Knorr and her associates also look at the non-technical resource relationships, the presence or absence of homogeneous scientific communities and the absence of universal criteria for evaluating knowledge. They lay greater emphasis on the process of knowledge production than on the actual performance of the scientists.

It is at the backdrop of such concepts such as 'scientific community' and 'resource relationships' that one can understand the utility of terms like 'mentoring' and 'networking' which are of particular relevance in studying women in science. Mentors are usually highly successful persons who occupy leadership positions in their own field. They play a key role in the professional development of the newcomers (Levinson, 1978). As teachers they help to enhance skills of young scholars and guide their intellectual progress. As sponsors, they exert influence on

entry into the profession and subsequent mobility. Kanter (1977) argued that mentors act as advocates for those under their guidance and can negotiate around established procedures and policies. Therefore, mentors generate power. They also help people to believe in themselves and in the feasibility of their goals. To Kanter, mentors are absolutely essential for women because the conditions for achieving success are already difficult for them.

It has been found that the mentoring process is largely unavailable to women because it is male dominated and cross-gender mentoring relationships are not very successful (Pattatucci, 1998). Caplan (1993) states that in male dominated disciplines, the higher a woman goes up the academic ladder, the greater becomes the scarcity of mentors. For women scientists at the higher levels of scientific hierarchy, approaching a potential mentor, connecting with non-academic staff and administrators become more and more difficult tasks.

'Networking' refers to the development of informal relationships with the other faculty, with colleagues both inside and outside one's department, and from all ranks and different institutions. A person may have several mentors who perform different roles (Collins et al., 1998). Networks have many advantages such as providing emotional support in dealing with stress, professional support when you come up for review in your department, advice on how to deal with the work related problems and information about teaching, job-hunting, publishing, informal norms of the scientific institution, and so on. Networking is also an effective way to identify gender discrimination and reduce feelings of isolation and vulnerability.

Long and Fox (1995) point out particularism in scientific career for women and minorities. Particularism is evident with respect to rank advancement and granting of tenure. Less prestigious institutions tend to employ more women. It has been observed that performance is not only a product of motivation or ability but also of background and environmental context, such as, mentorship, advising, collaboration, and institutional facilities. As a result of particularism women are less able to translate their productivity into resources and recognition than men are.

1.5.2 Women in professions

Studies of women in profession have considerable bearing on the situation of women in science and technology.

Collins et al. (1998), describe the problems encountered by women in academic research in the West. They suffer from discrimination in pay, promotion, and job status. However, these are not the only sources of stress for women academics. Women also experience other forms of discrimination in their interactions with colleagues and students. Female professors report of colleagues subjecting them to sexist comments, disparaging their scholarship, and behaving condescendingly and excluding them from important networks. Students tend to overestimate the performance of male professors and underestimate those of female professors. Male students show higher levels of discrimination (e.g. more disruptive of classes taught by women faculty) than female students. A competent woman is often less liked, and may be seen as a threat to less competent men. Subtle discrimination at the organisational level is common in faculty recruitment

and promotion. Institutional discrimination occurs in terms of gendered curriculum and gendered campuses. For example, a lack of research on women's health problems, their underrepresentation in anatomy textbooks indicates a gendered curriculum. Campus divided on gender lines is visible at some institutions where sciences are mainly male dominated and other faculties by women.

Collins et al. (1998) advise on how to handle difficult situations and provide encouragement to persist and achieve one's career goals. They suggest various remedies such as lawsuits at the individual level, altering exclusionary policies at the organisational level, and a massive infusion of women at institutional level to counter subtle sex discrimination.

Evetts (1994) studied women's career in engineering. She observed that there is a growing presence of women in traditionally male positions. This has heightened the contradiction or the dualistic experience of being 'feminine' and 'businesslike' at the same time among the women. Men do not experience the same contradictions between gender and professional identities because the professional identity has a male character. She collected data from career history accounts of fifteen women developing their professional engineering career in a high technology engineering company. Evetts also focused on different ways in which women cope with the expectations of promotion in the professional career. She found that some women in engineering opted for a professional ladder and avoided management responsibilities while building a reputation as a competent engineer. Through this, they accommodated private responsibilities and career. Some women delayed promotion to a managerial position until personal

responsibilities had eased. Those who adopted career as managers had to be more single-minded in their career dedication so that personal relationships were fitted around managerial roles.

Women are not passive when faced by discriminatory practices. In a recent study of women managers in the public organisations in Britain, Maddock (1999) found that although thwarted by male gender cultures, women challenged institutional practices in order to transform public sector management and to develop more equitable and better local services. Thus, while women are often victims of discrimination, they also bring about a transformational process through which they break institutional and professional barriers.

Some of the early studies on women workers focused on the innate biological differences between males and females (e.g., Bartol, 1976; Schuler, 1975). Gradually the interest of researchers shifted to the study of values. Research has shown that observed sex differences in work values are merely a stereotype. Rowe and Snizek (1995) obtained 12 national samples contained in the General Social Survey in the USA from 1976 to 1990 and analysed the work values of 7,436 full-time male and female workers, representing all major occupational classifications and all major industries. The data provided no consistent support for differences between men and women's work values. Instead, the data suggested that one's preference for a given work value depends largely on one's age, education and occupational prestige (for example, the importance of work as a means of accomplishment was positively related to age, education and occupational prestige). This was true for both men and women. The authors argue that the alleged gender differences are minimal and that the continued emphasis

on differences merely reinforces traditional gender-role stereotype and serves to perpetuate gender inequality in the workplace.

Another aspect of the women in professions is the relation between career and family status. According to general opinion, women less involved in family (single or childless) are expected to have a higher job involvement than women involved in family. Carrier (1995) examined the impact of family status on a woman's career and on career outcomes such as job satisfaction and the employment situation. She surveyed 1,294 women in Quebec (Canada), who were engineers, chartered accountants, physicians, and lawyers.

Carrier found that, compared to women with children, childless women felt more involved in their work and worked more hours per week. However, organisational tenure (i.e., length of time in an organisation), positional tenure (length of time in a present position) and job satisfaction were not related to the family situation. About 75% of partnered women with children were committed to a full time career. She argues that family obligations do not have the same negative effect on all women. Instead, there are personal factors (abilities in time management, and liberal or traditional attitudes), family factors (a spouse's help in house keeping, availability of child care, mental and physical conditions of the children) and organisational factors (child care at work, flex-time) that facilitate or impede women's professional career.

In India, studies of working women have focused on work motivation, the dual role leading to role conflict or role satisfaction and home and job adjustments. The structural and organisational problems within a profession have begun to attract attention only recently. For instance, some studies of women in

the organised sector (such as banks) point out the problems faced by women. These problems include, a denial of important responsibilities and a feeling of isolation due to patriarchal beliefs of colleagues (Kanhere, 1995), an inability to be assertive before male subordinates, and a greater susceptibility to role stress (Pandey et al., 1995). In a study of career paths of women in management, Parikh and Shah (1994) discussed several organisational and internal barriers to women's growth in management. Discrimination against women in promotions, difficulty in influencing superiors, and, in general, a carry over of patriarchal and hierarchical social structures to organisations acts as organisational barriers. Internal barriers included a lack of mobility, a need to maintain distance with male counterparts which deprived women of information about internal politics, and woman's avoidance of odd hour duties.

Summing up the above literature on professional women, studies on women in various professions reveal a presence of discrimination, both overt or covert. These studies reveal that women experience a contradiction of their feminine and professional identities, and must often contend with domestic responsibilities as well. Also, work values of men and women are not different and family responsibilities do not necessarily have an adverse impact on the career.

1.5.3 Women as Tokens

One of the significant concepts generated by the studies on women in male dominated professions is that of 'tokenism'. Kanter (1977) introduced the concept of 'tokenism' to describe the situation of those in the minority, regardless of whether the token is defined by gender, race or any other category. In her study of

a corporation where the ratio of men to women was 85 to 15 (about 17%), she found three dynamics of token situation. They are heightened visibility, boundary heightening and role encapsulation. Heightened visibility means that tokens are watched more carefully; their blunders and successes are in the spotlight. Boundary heightening refers to the fact that there is an increased awareness of tokens in the form of stigmatisation or social prejudices that often lead to their exclusion from informal socialisation. Role encapsulation suggests that the tokens are cast into stereotyped roles. Kanter's concept of token can be applied to women in academic science because they constitute a minority in this profession.

1.5.4 Barriers to women in science: Western studies

In the West, the research on women in science has highlighted their underrepresentation in this profession, the problems they face and the reasons for the problems. In the U.S., only 18% of the employed doctoral level scientists and engineers are women (Long and Fox, 1995). Stereotypes have been preserved in physics, geology and engineering. Women scientists earn lower salaries than men in the similar positions. While women have the strongest representation in the non-tenure track academic positions, their representation steadily declines as they climb up the academic ladder. They face discrimination in appointments to administrative positions, get less peer encouragement, have less mentoring, and experience greater isolation (Holloway, 1998).

Traditionally, two reasons are given for the underrepresentation of women in science. First, females have been alleged to be less adept at abstract reasoning, which is a pre-requisite for success in science. Second, women may exit the scientific career at any time to fulfil their 'natural maternal instinct'. Undoubtedly,

there are some women who have an interest in science but they do not pursue it because of their dislike for abstract reasoning. Some women do accord a higher priority to family responsibilities than to employment and therefore drop out. But new findings in this area show that these are not the sole or major factors contributing to the underrepresentation of women in scientific careers.

Pattatucci (1998), writing from her own experience in scientific career and from her knowledge of other women says that for those who abandoned their science career, the reason was not related to family but the 'extra stuff'. She defines it as 'a blanket term encompassing all gender -related challenges and boundaries faced by women in science over and above those inherent to the field and experienced by all persons aspiring for a career'. On her speaking with these colleagues, 'a picture of frustration and disillusionment with science emerged. They all had the common theme of burnout, not with the science itself, but with the extra stuff' (Pattatucci, 1998, p.6).

Pattatucci collected essays from women in science in U.S. These essays show that there is a climate of general hostility to women in science, a general belief in women's intellectual inferiority, and a lack of role models, mentors and institutional support. Uncooperative spouses and family roles have also affected women's careers. The barriers encountered by women in science have been sometimes referred to as the 'glass ceiling'. She documents researches, which show that women are discouraged right from childhood. Parents, for example, have lower expectations from their daughters than from their sons; from kindergarten to college, boys and girls (in schools) in industrialised nations constantly portray scientists as white men in labcoats wearing glasses. Media

further reinforces the sex-stereotypical images of boys and girls. The boy is interested in cars, sports and computer technology, while the girls are shown as immersed in dolls and frills. (Pattatucci, 1998). As Benokraitis remarks, 'at many points in their lives almost all women will be treated stereotypically ... because they are women and regardless of other characteristics', such as intelligence and talent (Benokraitis, 1998, p.5). This stereotyping and sex-discrimination is often subtle. It is an unequal or harmful treatment of women that is less obvious, but it could be intentional and is just as harmful as blatant discrimination.

Some researches in the West use the 'science pipeline' model to think about how talent pools are formed for the scientific professions. The image is one of a training pipeline running from early school through advanced training in the university to the hiring of professionals in the job market. Research on women's participation in the U.S. has shown a pattern of reduced mathematics and science courses and achievement during the high school years. Hanson and others (1996) used this model and cross national data to examine women's participation in science education and occupations in seven countries. The findings show that women's participation in the science occupations cannot occur without participation in science education. However, there is a greater equity in science and mathematics education than in science and mathematics occupations. Various cultural and structural factors keep women out of such jobs. They include cultural norms about the roles of men and women, the extent of state involvement in educational and occupational planning, and the degree of social inequality.

A recent study by Etzkowitz et al. (2000), found that women face gender related barriers in entry and progress in scientific careers. The authors focus on the

quality of women's experiences in academic science. Based on several studies including personal accounts and quantitative surveys, it provides a life-course analysis of women in science from early childhood interest through graduate school, the university, and the academic workplace. The authors show that science is an intense social activity that is influenced by the prejudices of the society. Unwritten rules and subtle barriers affect a woman scientist.

In 1986, physicist Dresselhaus offered the theory of 'critical mass', suggesting that women experience lower career obstacles once their numbers reach 10 to 15 percent of a particular group. The logic being that once critical mass is approached, women can reshape gender relations within a classroom, a laboratory, a department, or a discipline. The lack of an adequate number of women in science has been considered a serious barrier to women in science. Thus, one can combine the concepts of 'tokenism' and 'critical mass' to infer a dialectical relationship between 'tokens' and the larger profession. Once the tokens achieve a critical mass in their organisation, tokens may be in a position to challenge the prevailing organisational practices leading to a more egalitarian system and rendering the concept of token invalid. Looking at their relative size in academic science, women may be considered as tokens in the majority of institutions and organisations in India at the moment.

Critical mass is important in bringing an increased acceptance of women in a male dominated profession. However, the organisational structures and the mental set up that discriminate against women cannot be changed merely by increasing numbers of women. Moreover, critical mass theory assumes that women are a unified group with common goals. Etzkowitz and his colleagues

(1994) compared departments in which critical mass had been attained to those in which it had not been attained. They found that as the number of women faculty members in a department increased, they separated into sub-groups that could be in philosophical disagreement with each other. From a critical perspective it avers that the theory overemphasises women as agents of change in the gender structure of science (Schiebinger, 1999).

Another group of studies looking at the causes of female marginalisation examines the quantity and quality of work done (measured in terms of citations and rewards) by the female scientists, and, their power and prestige in this field. Jonathan Cole of the Columbian tradition of sociology (the Mertonian tradition) sets out to answer the question: 'could an institution (American science) that so nearly approximates the ideals of meritocracy fail to approximate such high standards in dealing with women of science?' (Cole, 1979, p.9)

Cole presents ten widely held beliefs about biological, attitudinal, structural and behavioural barriers to women in science, and demolishes all these beliefs. He concludes that science does operate universalistically and meritocratically, and that women who produce the same amounts of quality work receive the same jobs, honours and recognition from their peers as their male counterparts. For Cole, the biggest problem facing women scientists is that they do not publish as much as men and what they publish must be not as good as men's work because it gets cited less frequently.

But some subsequent research has found that citations are not necessarily a valid measure of quality. Edge (1979) has produced a critique of citation analysis as practised by the Columbian school. He thinks that its proponents make

implicit assumptions about the nature of science and their account excludes key features. According to him citing is a way of demonstrating that the authors belong to the 'right' circles. Collins (1985) sees citations as one of the ways in which new knowledge is brought to the attention of the core set. Core sets are small networks of scientists involved in particular lines of research, who legitimate the new knowledge in that area. Thus, citation is not a rational, universalistic behaviour.

Atkinson and Delamont (1990) contend that the position of women scientists is more complex and less under their control than Cole's arguments would suggest. Cole believes that if women published more and did better work, they would be rewarded accordingly. To Atkinson and Delamont, quality of work is a meaningless notion. Women scientists need to be visible to the core set members so that citation of their work has rhetorical power. Most women, trapped as instructors or assistant professors, are not visible to the core set and their publications are unlikely to be cited.

Such processes, according to Atkinson and Delamont, are a classic example of the 'habitus' of a profession -- that is, the 'indeterminate' part of the profession rather than 'technicity' (1990). Jamous and Pelloile first used these terms in social study of occupations. While 'technicity' refers to the rule-governed or codified part of a job, `indeterminacy' refers to the hidden aspects of job performance, such as unexamined ways of being a member of any occupational group, the informal rules, rules of thumb, genius, flair and other unspecifiable aspects of being a professional (Atkinson and Delamont, 1990).

Atkinson and Delamont argue that the marginal status of women in science is probably due to their failure to behave in ways which reveal their mastery of the indeterminate, that is, their failure to share the 'habitus' (1990, p.107). These researchers argue for an approach, which first identifies the habitus of the professions, and then addresses the issue of gender division in knowledge-based occupations.

1.5.5 Feminist positions on women in science

Feminism has had a powerful influence on all matters pertaining to sociology of women but there is not one feminist position on science. Feminist positions can be broadly classified as liberal, radical and post-modern. Liberal feminism is a belief that women are oppressed because they suffer unjust discrimination (Jaggar, 1983). Such feminists seek no special privileges for women and demand that everyone receives equal consideration without discrimination on the basis of sex. Extending it in science, it implies removal of social barriers preventing women from entering and succeeding in science. Yet they accept positivism in philosophy of science. They think that by removing barriers women will constitute about half of all scientists, equal to their proportion in the overall work force in population; that bias in science occurs because of human failure to follow scientific values of objectivity and value neutrality. This view seeks equity for women in science without attempting to change the way in which science is taught and practised. It makes no critique of the objective, universalistic and value neutral view of science.

On the other hand, radical feminists assert that there is a masculinist bias in the domain of sciences. Feminist scientists, such as Keller, a mathematician, Haraway, a hominid biologist, and Shiva, a theoretical physicist, have questioned the presumably 'objective' view of science. According to Keller, gender affects the production of scientific theory. She shows how the founders of Baconian science were suffused with masculinist metaphors. Through their critique of science, radical feminists claim that one cannot make any a priori assumption that gender is irrelevant to scientific practice (Wallerstein, 1999).

The demonstration of unscientific biases and androcentrism in science has led some feminists to search for women's distinctive 'ways of knowing'. In 1983, working on cytogenecist McClintock's understanding of the organism, Keller claimed that women could approach a problem differently. Though Keller never argued that women should employ distinctive methods in science, this work became an icon for 'feminist science'. In the 1990s the question re-merged as 'is there a female style in science?' However, as Schiebinger (1999) says, this is merely a hypothetical issue. While it is true that women have entered into some fields of science, particularly in medicine and primatology and these subjects have undergone changes in their content; but these changes are a result of complex factors and are not merely a product of feminist intervention. According to Schiebinger (1999, p.105), instead of focussing on female style in science, 'what is needed is a critical understanding of gender, how it works in science and society...'

Another approach to look at gender in science has come from 'postfeminism'. The postfeminist theory includes elements of poststructuralism, postmodernism, and feminist cultural studies (Sabbarwal, 2000). It dissolves the

possibility that women speak in a unified voice or that they can be addressed universally. Race, class, nationality, sexual orientation, and other factors prevent universalism. Postfeminism maintains that no one approach or solution will work for attracting all women and girls to science. The standpoints and experiences that determine a woman's decision to become a scientist are shaped by a multitude of factors other than gender. They include class, ethnic background, family dynamics, education and intellectual capabilities (Rosser, 1998). Such multiple approaches have been employed in Women in Science Project (WISP), initiated in 1990, in Dartmouth College (U.S). It uses a number of strategies to attract women in science, such as:

- part-time internships for first year women
- mentoring programmes
- seminars and informal opportunities to talk to women scientists
- industrial site trips
- a science study room with women tutors

While radical feminists find a revolutionary potential in the concept of gender and believe that men and women have different approaches to science, the postfeminists deconstruct gender and attach more importance to micro-identities involved in the everyday world of life. They point out that science is the product of the culture and context in which it is conducted. Feminists of both streams agree that there is no such thing as value-free science.

1.5.6 Barriers to women in science: Indian studies

In India structural barriers to women in education and science are much deeper than in the West. The roots of such barriers lie in history. Prior to the

starting of liberal education under the British rule, girls were considered unfit for formal education. Traditionally, women were associated with family responsibilities, and preoccupation with female chastity led to social practices to control women through seclusion, segregation, early marriage, denial of public spaces, and rigid notions of 'male' and 'female' work spheres. This ideology resulted in a lack of education among women. An 'ideal Hindu woman' is a householder and this image dominates and co-exists with other images even now (Chanana, 2001).

Indian social reformers believed that women need a different type of education than men. This notion arose from the different conception of roles of men and women. According to the social reformers, women were to receive education mainly to be better wives and mothers. The school curriculum was expected to reinforce the traditional roles of women. Separate arrangements had to be made for girls' education such as women escorts, women teachers, separate carriages or covered palanquins which are referred to as the *zenana* system of schooling (Chanana, 1994; 2001).

In the post-independence period, the Constitution of India guaranteed equality and social justice. Education has been seen as an instrument for providing equal opportunities for women. However, under the influence of tradition, gender relations remained greatly unchallenged. Science and engineering degrees bring in greater prestige and job opportunities. Yet, most families are less inclined to invest family resources in the academic achievements of their daughters rather than their sons. It is assumed that after marriage benefits of their education would accrue to their husband and his family. Many parents perceive a danger of sexual

pollution in sending girls to predominantly male colleges. Fear of travelling alone across towns, odd hours, long periods of study and danger of not finding a suitable groom (of higher education and age) constitute barriers to women's education in general. Schools also discriminate in overt and covert ways. Formal and informal counselling in schools limits the choices of subjects and disciplines for girls. Many principals of girls' schools do not offer science subjects at the plus two or higher secondary stage (Chanana, 2001).

The situation is changing in some ways. Prestige associated with academic achievements, earning capacity and thereby better chances of getting a good match are some factors that are motivating parents to provide higher education to girls (Mukhopadhyay, 1994). Several states have fixed quotas for girls in admissions and their ratio in science and engineering colleges.

However, attaining an environment, in the society and the institutes, that is free from gender bias is still a far cry. Women with high education in science are still a minority group in India. Despite the social and organisational problems, they never articulate their grievances as a group. Listening to this group may be illuminating about the profession as a whole. It might also reveal hidden forces of society that work against women. It may be noticed that these women in science and engineering, although small in number, reflect the growing pool of women intelligentsia. Their problems and conditions need to be highlighted so that they are able to contribute to society to their fullest.

First effort to highlight the trials and tribulations of the Indian women scientists was made in 1975, the International Women's year. In this year, women scientists in India founded the Indian Women Scientists' Association (IWSA) and

published a commemorative volume in 1978. It contains the experiences of the Indian women scientists and the problems faced by them during the 1930s and 1940s. One case was that of Kamala Sohoni. She was the first woman to obtain M.Sc. from Bombay University and the first woman to be admitted to the Indian Institute for Science, Bangalore, for Ph.D. (*IWSA Newsletter*, August 1997- March 1998). Sohoni writes that she was unfairly denied promotion to the post of director in Nutrition Research Laboratories at Coonoor. Petty jealousies in an institute dominated by men denied her the opportunities to attend international conferences and allied activities (IWSA, 1978). The accounts of other women scientists in this volume indicate that in most cases the support of a father and husband was important in the success of women's career.

A survey of women scientists at Bhabha Atomic Research Centre (BARC) by Begum and Balaraman in the early 1970s found that due to socialisation in a patriarchal culture and a lack of childcare facilities women have to work harder than men (Subrahmanyan, 1998). Gurnani and Sheth (1984) found that women scientists felt that their male colleagues and superiors do not accept them professionally. Chakravarty (1986), in a study of the productivity of Indian women scientists, reported very few women scientists holding senior posts in Centre for Scientific and Industrial Research (CSIR) institutions. In a study of women scientists in 600 research units, she found that women spent lesser time on administrative activities compared to men; they are less involved in activities of research; and the research productivity of single women is not more than those with family. She also emphasised the role of prejudices, the lack of infrastructural support and the dual burden for women scientists.

The 1990s saw the emergence of more detailed studies on women in science highlighting various dimensions of the question. Using questionnaire and 30 in-depth interviews, Krishnaraj (1991) studied 400 women (with science degrees) working in science establishments in Bombay. Using feminist materialist theory, Krishnaraj demonstrated how patriarchy operates at work and family. Interviews of women scientists who were not employed were also conducted. It was observed that the involuntarily unemployed women not only faced the problem of getting a suitable job but also faced discrimination in industrial organisations. Those who were voluntarily unemployed faced various social and familial problems. She also studied the presence of a scientific outlook among women scientists. The study reported that relatively younger women or women with science backgrounds were less traditional in outlook than others.

Jaiswal (1993) compared the professional status of women and men scientists and engineers. He collected data (through questionnaires) from 24 science and engineering organisations at Madras, Bangalore and Trivandrum. He found that (a) women in this profession came from better socio-economic backgrounds than men; (b) the status of women's spouses was higher than the status of men's spouses; (c) the majority of women were at a lower level of professional hierarchy; (d) women had a lower level of job satisfaction and a lower level of job commitment than men; (e) there was latent discrimination against women, both at organisational level and in relationships; and (f) the families had a patriarchal authority structure.

Mukhopadhyay (1994) has examined the role of patrifocal family structure and ideology in women's underrepresentation in science and engineering

education. She found that patrifocality in family is manifested in the different educational obligations of sons and daughters, and in the different educational goals for them. Thus, for example, due to marrigeability risks and relative social dangers associated with engineering for girls (such as dangers in sending her outside the hometown for engineering education, and staying in a hostel), most families prefer medicine or pure sciences to engineering. Subrahmanyan's (1998) study of women academic scientists is a major milestone in this area. Based on an in-depth study of 37 women on the science faculty at the University of Madras, it deals with the problems that women scientists encounter as the Third World scientists and problems that are related to gender alone. Adopting the framework of patrifocality she tries to explain how it affects women's entry into science, and the spill over of patriarchal considerations into the workplace.

An empirical study of men and women scientists in academic institutions and national laboratories was conducted by Kumar (2001) to study whether universalist criteria exist for women in the Indian system of science. His statistical analysis shows that there is gender discrimination in the hierarchical distribution of women within scientific institutions. The higher the rank, the lower is the percentage of women. Career paths for women were flatter than for men and disparity in academic rank existed even though both men and women had similar productivity. This shows that Indian science is under the influence of paticularistic norms and the discrimination against women is a reflection of larger social values.

No study of women academic scientists has been carried out on the IITs (Indian Institutes of Technology) or the universities in North India. Thus, there is a need to examine whether the most prestigious science institutions in North India

are free of social biases. There is also a need to identify diverse factors affecting them. Organisational and institutional aspects of the profession, its overall environment, and their impact on women have to be studied in depth. Such studies will point out the lacunae in the present system and suggest ways to rectify the situation. The present study is an attempt in this direction.

1.6 Conceptual Framework of the Study

This study has developed a conceptual framework to study the problems of women scientists. It combines concepts from the sociology of science, the sociology of profession and gender studies. Early sociologists of science in Mertonian tradition considered science as a universalistic profession where all are treated equally based on merit, and rewards are fair. Of late the post-Mertonian sociologists have discovered the presence of non-universalistic aspects of role performance of scientists and emphasised the role of contacts and networks in building a successful career. These particularistic aspects in science have some unique implications for women.

Particularism in science has been related to the formal and informal aspects of the profession of academic science and the indeterminate elements involved in it. Formal aspects of the profession relate to the rule governed aspects such as appointments, promotions, etc. In industrial sociology, 'formal organisation' is defined as the deliberate and methodological organisation of human element of industry designed to achieve its objectives (Gisbert, 1972). Thus, various levels of authority in an organisation, lines of communication, written specifications of individual relationships in the group, rights, privileges and duties formally assigned to personal and group roles are included in the

formal organisation. The term 'formal environment' of the profession has been used in this study, in place of 'formal organisation', which means not only the formal manner in which the profession is organised in an institute but also the technical and rule related aspects of practice in this profession. Hierarchy in an institute, rules relating to appointments and promotions form part of the formal organisation of an institute; getting funds from outside agencies, publishing papers, obtaining national or international fellowships involve rules, which are part of the profession. My study examines the tacit elements involved in both the formal environment of the organisation and the formal aspects of the profession.

'Informal organisation' refers to the groups and cliques that develop in any work organisation. It also consists of folkways, norms and values, which guide the behaviour of workers (Miller and Form, 1964). The term 'informal environment' has been used in this study in a similar sense; the only difference being in its usage in the wider sense to include not only an institute but informal relations in the wider community of the profession. Importance of informal relations and activities and women's participation in them are studied to understand the nature of issues faced by them. Thus, academic science is treated like any other profession. This study attempts to capture the viewpoints of women academicians about their profession, organisation and about science in general.

A woman academic scientist is not only a part of the scientific community. She also operates in a particular social context. The definition of the roles of men and women and the extent of their rigidity have implications for gender relations both in the workplace and in the family. Patrifocality and the resulting stereotypes exert a powerful influence on the professional women in

Indian society. The concept of patrifocality has been described in detail by Mukhopadhyay and Seymour (1994) and by Subrahmanyan (1998). It refers to the kinship and family structures and ideology that gives precedence to men over women. It includes subordination of the individual to the family; patrilineal inheritance, patrilocal descent and residence that reinforce centrality of males; gender differentiated family roles (woman's nurturing role and domestic roles vs. man's economic roles); patriarchal authority structures, regulation of female behaviour and marriage system including dowry. The ideology of patrifocality is reflected in various social stereotypes about gender roles. Conceptual model may be visualised as in the Figure 1.1:

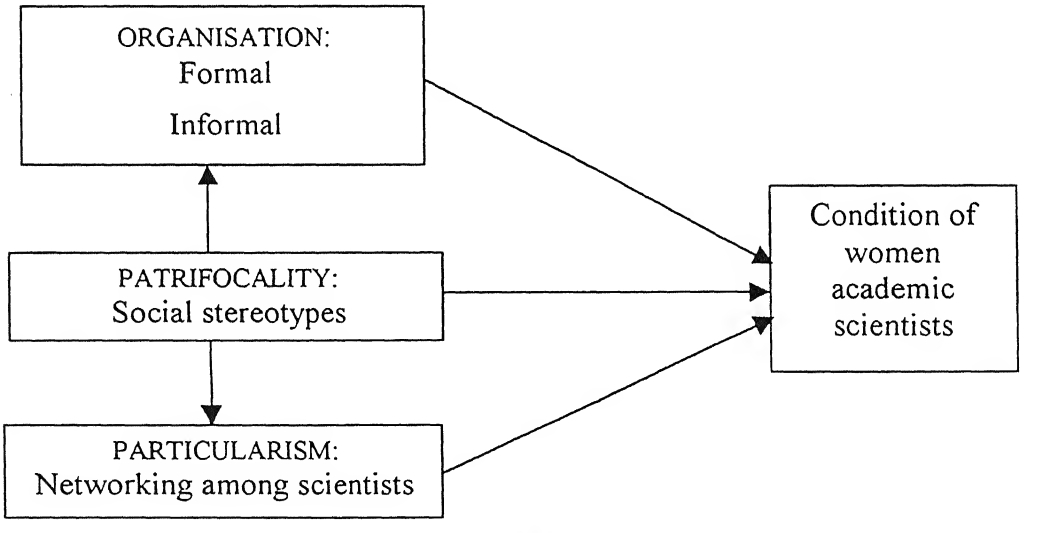

Figure 1.1: Organisational and Social Determinants of Condition of Women Academic Scientists

The figure above shows that there are three major influences that determine the condition of women academic scientists: Organisation, social stereotypes and networking among scientists. Formal and informal organisation of work and networking among scientists are influenced by stereotypes. Importance of networking reflects particularism in the practice of science.

1.7 Assumptions

Based on the literature survey the following assumptions are made in this study:

1. Social stereotypes about men and women affect women's entry into science. These social norms also influence the workplace and create a gendered environment of work.
2. Scientific profession, like any other occupation, has both technical and indeterminate aspects; women academic scientists either lack awareness of the indeterminate and informal aspects or they are unable to follow them due to social reasons. This inability to follow the indeterminate aspects of norms affects their career progress.
3. Social background and family support play an important role in women's scientific careers. Lack of this support has an adverse effect on their career.
4. It is not enough to be brilliant and do good research to be successful in the academic world. Mentors, networks and contacts are quite important as well.
5. Lack of a 'critical mass' in science affects women's ability to deal with gender-related problems. The presence of a supportive network could facilitate many women's success.

1.8 Objectives of Study

The main objectives of the study are as follows:

1. To study the background of women academic scientists in selected institutes of higher learning and research.

2. To explore the nature of the formal environment of work and its impact on women academic scientists.
3. To study the importance of and participation in informal activities, contacts and networking by women in academic science.
4. To study the perception of women academic scientists regarding the presence of gender bias in the institutes.
5. To study if there is a gender related stress on women academic scientists at the workplace.
6. To study the impact of multiple roles, including work roles and domestic roles, on the career of women academic scientists.

1.9 Research Questions

The following research questions emerge on the basis of the literature review and the above stated objectives:

1. How does family background influence the decision of women academic scientists to enter the scientific profession? What is the nature of family support in entering a scientific career?
2. What is the perception of women regarding the rules and procedures in the institution? Are there certain tacit elements involved in their application?
3. Do the women scientists think that rewards in science are based on meritocratic or some other principles?
4. What are the problems faced by women as 'scientists'?
5. What is the role of research and teaching in the careers of women academic scientists?

6. What is the nature of interaction and networks between the women scientists and their colleagues, seniors, administrators, and students within the institution and, between the women scientists and others (such as, other scientists, bureaucrats) outside the institution?
7. What is the level of participation of women academic scientists in the various informal activities of the institution and the impact of such participation?
8. In what way does the lack of a critical mass lead to tokenism? What are the gender-related perceptions of the women academic scientists in the institute and in the scientific profession as a whole?
9. What is the impact of marriage and family responsibilities on the careers of women scientists? How does the family role affect career outcomes like, job involvement and job satisfaction?
10. How do such women negotiate their multiple roles? How do they define 'success'? Do they consider themselves successful or not?

1.10 Organisation of the Thesis

This thesis is divided into seven chapters, references and four appendices. The first chapter, as seen above, stated the problem and presented the review of the literature, the conceptual framework of the study, the objectives and the research questions. Chapter 2 discusses the methodology and the research design. It describes the institutes and the universities that this study examines, describes the method and the data collection process. Chapter 3 analyses the data on the social background of the respondents, their professional profiles and their perceptions of academic science in India. This gives us an idea of the importance of social and familial influences on women academic scientists and provides a

picture of the backgrounds of the respondents. Chapter 4 examines the formal environment of the scientific profession. It looks at the structural and institutional aspects, which are rule-governed and involve specific procedures. Chapter 5 focuses on the indeterminate aspects of work, such as the role of contacts, interactions, informal relations and activities in the role performance. Chapter 6 analyses the impact of the work environment on women scientists. It also looks at the nature of the dual burden on women and discusses their responses to the stress emanating from their multiple role performance. Chapter 7 summarises and discusses the findings. The references and appendices follow this. Appendices contain the instruments of data collection (questionnaire and schedule) and two documents cited as evidence.

CHAPTER 2

RESEARCH DESIGN AND METHODOLOGY

2.1 Introduction

This chapter discusses the methodology used in the study. The study has made use of the triangulation method to study women scientists for collecting quantitative and qualitative data. Four reputed institutes / universities* were selected purposively to study the background, experiences and perceptions of women academic scientists. This chapter begins with a brief introduction of these institutes. Then it goes to the method of selection of respondents, tools used for data collection, their testing through the pilot study, field experiences and analytical techniques.

2.2 About the Institutes

Considering the small number of women faculty in the technology institutes and universities, a total of four institutes of higher learning and research in technology and science were selected. They are the Indian Institute of Technology Delhi (IIT Delhi), the Indian Institute of Technology Kharagpur (IIT Kharagpur), Jadavpur University (JU) and the University of Roorkee (UOR). While UOR is close to IIT Delhi, JU is close to IIT Kharagpur. Initially IIT Kanpur was also included in the study. However, since the

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* In this study, for brevity, both institutes and universities are referred as institutes. To hide their identity they will be called Institutes A, B, C and D.

researcher is part of the residential campus at the Institute and the majority of women faculty are known to her, there was a fear that their answers might not produce an unbiased picture of the reality. Hence it was dropped from the final study.

There are several reasons for choosing these institutes. The IITs have a worldwide reputation for excellence in technological education and research. Roorkee and Jadavpur universities are also among the few well-reputed universities with a strong tradition of teaching and research in science and engineering. They are next only to the IITs in the quality of teaching and research. UOR has been recently granted the status of IIT. JU is one of the seven universities recently identified by the Expert Committee of University Grants Commission (UGC) for granting the status of "University with Potential for Excellence", the others being Jawaharlal Nehru University, Roorkee, Pune, Madras, Punjab and Hyderabad universities (University News, 2001).

No one would expect that these institutes would have biases and prejudices against any group, including women. One expects that they are not only great centres of science and engineering, but that they also have a universalistic scientific culture. Yet the number of women faculty in science and engineering in the four institutes is very small and to study the challenges posed to them in the overwhelmingly male environment seemed to be promising. Moreover, no study has ever examined women's roles at these institutions.

Though IITs and the two universities represent two different types of cultures and sources of funding, it was assumed that when it comes to the situation of women academic scientists they have many similarities.

2.2.1 The Indian Institutes of Technology (IITs)

The IITs originated as part of the vision to set up a chain of 'MIT type' institutions in India. They were set up between 1951 and 1963 under the provisions of an Act of Parliament in 1961 and amended in 1963. They were expected to provide scientists of the highest calibre and to make the nation technologically self-reliant (Indiresan and Nigam, 1993).

The pattern of control and method of instruction at the IITs were planned as a major departure from the prevailing system in other technical institutions and universities. They were vested with considerable administrative and academic autonomy. They were financed by the Central government. The IIT council is an apex body laying down policy guidelines for the IITs. It is chaired by the minister in charge of technical education. Each institute has a Board of Governors and an academic Senate. The former is responsible for administration, the latter for the academic affairs. Unlike universities, politicians or bureaucrats do not form part of these bodies. Also, the role of the chief executive (director) of an IIT is very specific and not diffused or total as that of a vice-chancellor of a university is. He is not the chairperson of the managing body (Board of Governors) as in the universities, which takes the pressure off him in terms of making decisions on irresponsible demands of employees, since the final decision rests elsewhere.

Academically, an IIT has some special features, such as integration of sciences, engineering and humanities, a semester system of examinations, internal evaluations, and a grading system different from the universities. IITs conduct their own examination, the

Joint Entrance Examination (JEE) to select undergraduate students, and Graduate Aptitude Test Examination (GATE) to select post-graduate students. JEE is one of the best administered examinations in the country and provides a model of academic testing and fairness to other institutes and universities.

Faculty members at the IITs enjoy a special status in terms of salary and perks as per the Pay Commission norms. They are treated at a higher level compared to the faculty in universities. The faculty members are seriously engaged in research with a large number enjoying national and international recognition.

However, the system is facing certain problems. The post-graduate programme does not have the same rigorous standards as the undergraduate program. Merit is lowered to reserve 22.5% seats for the scheduled castes and scheduled tribes. A large number of faculty members are retiring every year. Attracting outstanding faculty is becoming increasingly difficult. Inbreeding is also becoming a problem. There is a general lack of motivation among post-graduate students (due to lucrative salaries in industrial jobs for graduates), a decline in enthusiasm among the supporting staff and the problem of brain drain (Indiresan and Nigam, 1993).

2.2.2 University of Roorkee (UOR)

UOR was established by an Act of Uttar Pradesh Legislature passed in 1948 and was formally inaugurated in 1949. It is situated in the newly created province of Uttranchal. Its roots go back to the 19th century when the British established Thomason College in 1847 to train civil engineers for public works in the country. Till 1870 only a few Indians were admitted in engineering. Between 1870-1910, the college recruited a number of Indians in various positions, though staff at the top and the middle levels

remained British till much later. Before 1920 military engineers who also looked after the Public Works Department managed the college. Thus, civilian staff and students were subjected to army discipline as well. The management became civilian in 1920 but the college continued to meet the military needs of the British. Graduate courses in mechanical and electrical engineering were introduced only with the formal inauguration of the University. Postgraduate courses began in 1953 (Mital, 1997).

The Act provided for two statutory bodies. One, a senate that is the governing body and second, a syndicate which is an executive and academic body. Both the bodies included government nominees. The senate included members from the legislative assembly, representative of the Central government and a few bureaucrats. The provincial government provided UOR with all the financial support. Though one of the finest institution, it started developing an 'inferiority complex' (Mital, 1997, p.163). This was mainly due to the rise of the IITs and their favoured status. Bureaucratic control and a shortage of funds were other problems. In the 1980s massive financial aid through Central ministry and UGC were granted to it. In 1995, the nomenclature of three categories, professor, reader and lecturer was changed to professor, associate professor and assistant professor. The assistant professor was given the reader's grade and the cadre of lecturer was to be phased out. Ph.D. was made compulsory for all appointments. The proportion of posts in the three cadres was kept flexible. This arrangement is similar to the IIT system of faculty cadre. Since 1980s there has been a spurt of activity in favour of 'special status', 'Central take-over', etc. which has now culminated in the granting of IIT status to the university. At the time of our study, the change of UOR to IIT Roorkee had not been implemented.

One of the important features of the university is the role of the Head of the Department. Before 1975, he was the seniormost teacher of the department and exercised considerable authority. After a resolution of 1975 was passed, the headship was offered to senior teachers by rotation. However, respecting senior teachers and the authority of headship is part of the university culture, which has led to considerable hierarchy in the faculty ranks. Problems of inbreeding and favouritism are also often reported.

Since 1994, caste has become a source of discontent, as the State government passed the order for reserving 50% of the teaching positions for the Scheduled Castes, Scheduled Tribes and the Other Backward Castes. When the researcher visited the University, the interviews for promotion had been withheld in some departments due to the reservation issue. A woman faculty from a lower caste had been instrumental in getting the stay order from the court. This lead to some negative comments from men faculty against all women faculty.

2.2.3 Jadavpur University (JU)

In contrast to the UOR, which was established by the British, Jadavpur University was founded at Kolkata as part of the nationalist movement for indigenous education in the modern sector. The history of JU goes back to the Swadeshi Movement (1905-6) when the provision of an education had to be made for students boycotting schools and the need for national education was felt. In 1906, the National Council of Education (NCE) was established under the presidentship of Rash Behari Ghosh to impart education under national control. At the same time, the Society for the Promotion of Technical Education was also founded and merged with the NCE in 1910. The society, which looked after the Bengal Technical Institute, was now administered by the NCE. In 1924

the Institute shifted to its present location at Jadavpur and was given the nickname of 'Jadavpur College'. Though the nomenclature of the Institute changed in 1928 (College of Engineering and Technology), it was formally known as Jadavpur University after the Government of India legislation in 1955, which granted it the University status.

Since the NCE was not recognised by the Government, it could not award degrees till 1944. Outstanding graduates were chosen and sent abroad for advanced education by the NCE, thus developing one of the best faculties in the country. Unlike UOR, where the programme in civil engineering was the main programme, the Institute started with the disciplines of Chemical, Electrical and Mechanical Engineering only. The first programme in Chemical Engineering in the country in the pre-independence period was set up in the Institute by Dr. Hiralal Roy, who was a graduate of the Institute and then sent abroad for higher studies in Chemistry (Chatterjee and Roy, 1996). Programmes in other engineering disciplines soon followed this.

JU continues to be a unitary university with research facilities for graduate and postgraduate education. Funded by the state government and by the UGC for specific schemes, its policies on expenditure are evolved by the executive council, finance committee and the working council of the University. There are three faculties - engineering, arts and sciences, each having a faculty council headed by a Dean. There is also a Dean of Students. Department level discipline is enforced by the Head of the Department under the policies formed by the Board of Studies. The University is well known for research and academics. It has five Bhatnagar Award recipients. Central Government departments and scientific agencies, (such as, Department of Atomic Energy, Department of Electronics, Defence Research and Development Organisation)

have set up various research cells. JU has obtained five patents in the last five years (www.jualumni.org). The University is presently facing a resource crunch. It is also heavily politicised due to the communist influence and existence of labour unions. A political affiliation of an individual with the ruling party in the state brings extra benefits (in terms of appointment and promotion as a faculty member, for example). There is a general laxity in the behaviour of the lower staff (such as coming late to the office in the morning, and leaving before the office closing hours in the evening).

2.2.4 Other points of comparison

There are differences in the appointments and promotions among the four institutes. In the IITs and UOR (since 1995) appointments to faculty positions are made only if the candidate has completed a Ph.D. At JU, a candidate about to complete Ph.D. may be considered for appointment. At both universities, promotion occurs only when a vacancy occurs. This often leads to stagnation since vacancy might not occur for several years. At an IIT, selection committee for promotions sits periodically. This is not the case with universities. There is greater autonomy to the faculty in the IITs in terms of designing the course structure, conducting examinations and provision of research environment compared to the universities.

Except JU, the other three institutes have residential facilities for both students and faculty on the campus. At the JU, the students and the faculty are mostly the residents of Kolkata. Hence, there are hostels for students outside of Kolkata and some quarters for the faculty, which are allotted on the basis of years of service in the University.

There are many similarities between the four institutes. They all have undergraduate and postgraduate teaching along with research facilities. Since the time of

their establishment, they are well known for their engineering and science education. Since women in engineering have been rare, these institutions essentially may be considered as having a system defined by men. While the criteria of essential qualifications and experience has to be met in appointments and promotions of the faculty members at all the four institutes, it is the number and quality of research publications, which is the most important factor.

2.2.5 Justification for combining the institutes for analysis

In this study, women academic scientists have been studied taking the four institutes together. The respondents of a particular institute do not form a separate chapter of study. There are several reasons for this. First, at any one institute the women academic scientists are very few in numbers. Hence, the problems arising in the work environment due to their small number in the total faculty strength are likely to be similar across the institutes. Second, though differing in culture, various parts of India share similar social norms that infiltrate the workplace. The social stereotypes affecting the lives and career of women are quite similar. Third, the purpose of the study was not to study a single institution intensively but to conduct an in-depth study of *women in this profession.* However, some differences among the institutions, which affected our respondents, are incorporated in the study.

2.3 The Respondents

Selection of the respondents depended on the way the term 'academic science' was defined. 'Academic science' is sometimes equated with 'basic' science and its opposite is 'applied' or industrial science (Haribabu, 1999, p.220). However, the term is not used in

this sense here. It is used in the sense of science (including engineering) carried out in academia.

Our respondents are academic scientists. They are either from the pure sciences or from different engineering disciplines. They have a doctorate degree and have been involved in research. Only four respondents are non-Ph.D.s, but all of them are involved in teaching and training students for research. We chose scientists in academic institutions and not in the research laboratories because academia is central to science and has even been characterised as 'the home of science' (Long and Fox, 1995, p.50). It carries out functions of both research and training. At present in India, scientific effort is concentrated primarily in the state-funded institutions and universities. The state-funded research laboratories neither teach nor train researchers. Further, the study does not include teachers in the affiliated colleges since they are mainly teaching institutions and have little involvement in research.

The four institutes included in the study have faculty in Humanities and Social Sciences (HSS) also. Since the study was confined to science and engineering, HSS faculty members were not selected. Thus, the women respondents of this study belong to the sciences (excluding biological and medical sciences) and engineering disciplines only.

Though science and engineering are different in their ethos - science being more academic and engineering being more applied - the two have some similar characteristics. Both are modern professions with power and prestige. There are several aspects of the definition of 'profession'. The most vital aspect is that those in a profession are seen to have authority and monopoly over the skills and knowledge in that field. Also, a

profession has 'professional culture' that implies a career and lifelong commitment to the work that goes far beyond the actual working hours. The code of conduct of a profession are guarded by professional associations (Auster, 1996). Given these characteristics, science and engineering may be viewed as professions whose members possess specialised knowledge and training. Both are professions with a distinctive code of conduct, and their professional associations guard the professional ethics and interests of the members.

Since the number of women faculty in each institution is small, an effort was made to contact the entire women faculty in science and engineering in their respective institutes. All faculty members are engaged in teaching and do some research also. As mentioned earlier, all women faculty members chosen (except four) have the Ph.D. degree. Two from UOR and one from IIT Kharagpur, are doing their doctoral work and are about to finish. Two of these three respondents are from the Department of Architecture and one from the Electrical Engineering department. One is only a postgraduate but she is in the Department of Architecture (at IIT Kharagpur) and is involved in guiding students for research. In Architecture, only those faculty members were included who have a basic (Bachelor's) degree in the discipline.

2.4 Methodology: Triangulation

In this study 'triangulation' is used for data collection. This method has not yet been adopted to study this problem. Triangulation refers to a combination of different techniques or methods to explore a given set of research questions. Two main tools, a questionnaire and a semi-structured interview schedule were combined together and used for collecting data from all the respondents (see Appendix A and B). Questionnaire is

commonly used for general survey, and semi-structured interview schedule for collecting in-depth data in a more flexible manner. Here, both the tools were used together to collect data from all the respondents. Apart from this, curriculum vitae of the respondents and secondary sources were also used.

2.4.1 Combining the questionnaire and interview schedule

In this study, I used both mailed questionnaires and interviews to collect data. There are usually two purposes in using triangulation: confirmation and completeness. When the approach is used for confirmation purposes, the individual strengths, weaknesses and biases of the various methods must be known and applied in such a way that they counterbalance each other. Use of triangulation for this purpose is more attractive to quantitative research because it can lead to a confirmation of hypotheses, a measurement of discrete variables and a development of scales. For obtaining completeness, triangulation can be used to study people's behaviour in detail and common behaviour patterns. This function of triangulation suits qualitative stance as well (Arksey and Knight, 1999).

In this study, triangulation is used more for the purpose of completeness than confirmation. The questionnaire was intended to provide quantitative dimensions of the problem and to collect data in statistical form so that the degree of commonness of perceptions and activities could be ascertained. The interview schedule was devised to provide an in-depth information about the same issues. The range of questions in the interview schedule was wider so that respondent could comment on different aspects of the problem relevant for this study. The interviews brought the researcher closer to the

research situation. Researcher's observations during the interview situation gave her confidence in interpretation of data.

Here, it might be pertinent to give some examples to illustrate the point. In the questionnaire, questions on participation in informal activities and their impact provide averages of the level of participation and relative frequencies (percentages) of responses on the impact. In the interview schedule, questions were asked on perception of respondents about their participation in academic life as compared to the men colleagues and reasons for the less or more participation (than men faculty) were ascertained. This helped to obtain holistic understanding of all aspects of participation. Questions on the existence and need for contacts, the nature of science in India and nature of work environment are included in both the questionnaire and the interview schedule. Overall, questions needing examples or probe were included in the interview. On the other hand, questions requiring agreement or disagreement were included in the questionnaire.

The method helped in various ways. The questionnaire and interview schedule complemented each other. A single aspect could be approached through diverse questions, which deepened the understanding of that issue. It gave confidence in the results and in the thoroughness of the study. Also, while the questionnaire made generalisations possible, interview schedule helped to provide the explanation of such generalisations. For example, questionnaire showed that women lack geographical mobility. The interview helped in ascertaining the reasons for lack of mobility and in revealing its consequences.

The questionnaire included questions on job satisfaction, job involvement and the feelings of the respondents about their profession that did not form part of the interview.

This was done to quantify such information and have the benefit of answering in anonymity in a questionnaire. Questions requiring examples from the respondents or their viewpoint in detail were included in the schedule only. Thus, example of a stereotype situation faced or a description of who is a successful woman was obtained through the interview schedule. This helped in making the study more complete.

Triangulation can pose problems when one gets inconsistent results from the use of different instruments. For some questions in the questionnaire, statistical results showed that less than half the respondents acknowledged a particular phenomenon. However, answers relating to the same phenomena in the schedule of some respondents indicated that the problem was severe. On the whole, researcher in such a situation placed greater faith in the schedule responses than in the questionnaire. This is because the responses in the interview were elicited through face-to-face contact with the interviewee.

2.4.2 Other sources of data

The study attempted to collect curriculum vitae from all the respondents. However, only 26 respondents gave it. Some did not have it handy, some had not updated their curriculum vitae and some were quite unwilling to provide it. Even those that were obtained were quite different from each other. Some did not carry any information on education prior to the Ph.D. Some stated only the total number of publications but did not divide them into papers presented in seminars, conference proceedings, edited books, etc. or publications in journals. Within journals, some divided them into national and international journals, or refereed or other journals, while some did not. In the absence of homogenous categories it was very difficult to analyse them. However, they may be used to assess the overall research activity of a scientist, and the years of publications may

give an idea of a scientist's most prolific period. We obtained detailed biographical information in the questionnaire itself. This helped us to study the class, social background, and influence of relatives, research activity and geographic mobility of the respondents.

Documentary sources such as, the rulebooks of the institutes, some official letters, Indian Women's Science Association's (IWSA) Newsletters provided important information. These documentary methods have an advantage of being unobtrusive rather than obtrusive.

2.5 Pilot Study

The first draft of the questionnaire and the interview schedule, was pretested on five women faculty members at IIT Kanpur in September 1999. The responses helped in understanding the best way of collecting data. For instance, I tried recording the interview. But the respondents were quite uncomfortable with taping. Hence, in the actual survey recording was not done. In the light of the response to the questions, modifications were made in the language and pattern of questions. For instance, in one question where the respondents had to indicate their feelings about their career, five-point scale indicating agreement or disagreement was modified to the five-point scale indicating how often the respondents experienced the situation. The original statement was: 'My job is too demanding to enjoy it'. Instead of asking the respondents to agree or disagree with the statement, the revised questionnaire asked how often they felt that their job is too demanding to enjoy it. This brought greater pointedness to the question.

During the course of the interview, the researcher realised that some questions needed to be rephrased so that the subtle aspects of the formal institutional structure could be brought out. For example, a question in the schedule was originally worded as:

> Do you think there are discrepancies in the appointment of male and female faculty in your institute?

After the pilot study it was rephrased as:

> If the bio-data of a man and a woman candidate are the same, will the institute prefer one over the other in appointment / promotion?

2.6 The Field Work

The work of sending questionnaires, receiving them and conducting the interviews in the four institutes was completed during the period ranging from December 1999 to September 2000.

It was not easy to get data from women faculty because filling up the questionnaire and giving the interview required on an average two hours which the respondents found difficult to spare. Efforts were made to establish rapport with the respondents. They were initially contacted through e-mails that stated the purpose of the research, the date of my visit to the institute for the interview, and that solicited their co-operation. Only in a few cases, e-mail addresses were not available or the mail did not reach the respondents. Subsequently, a questionnaire was dispatched (through postal mail) along with a letter reiterating the above. For those who could not be contacted on the Internet, questionnaire and letter were mailed directly to their offices. This gave the respondents enough time to fill out the questionnaire. The questionnaire was collected at the time of the interview. This had the advantage of clarifying any questions about the questionnaire, and completing any incomplete items. However, in some cases,

respondents were too busy to fill them out during the visit. In such cases the questionnaires had to be obtained through the post. A few respondents had to be sent two or three reminders and contacted by phone to fill and return the questionnaire

On reaching an institute, the respondents were contacted by phone and appointment for the interview was fixed. Most of the respondents adhered to the time they had fixed and the interview was postponed only in case of some contingency. An interview lasted from 35 minutes to 75 minutes. In most case it lasted for about 45 minutes.

Two questionnaires were not obtained at all and two got lost in the post. In one case, a respondent's husband filled it up. This was admitted by the respondent herself who is about to retire in a few months. Hence the questionnaire of this respondent was omitted from the data. According to her since her husband knows everything about her, he could easily fill it up on her behalf! At IIT Kharagpur, only 11 out of 17 women faculty in science and engineering could be contacted for the interview, but questionnaires could be obtained from 15 respondents. At JU there are 45 women faculty members. To avoid a disproportionate representation of the JU respondents in the sample, only those with Ph.D. degree were contacted (while in the IITs all respondents were Ph.D.s, at UOR very few were non-Ph.D.s. Only at JU, there was a high number of non-Ph.D. faculty). Table 2.1 gives details of responses received from the different institutes.

Table 2.1 excludes the faculty in the Management departments and training centres of the institutes. Out of a total of 96 women faculty in science and engineering, I was able to get response from 82 of them. Both questionnaire and interview schedules were collected from 72 respondents.

Table 2.1: Total Women Faculty in Science and Engineering and the Sample Size

Institutes	Total strength	Sample size			
		Total	Question-naire and schedule	Only schedule	Only question-naire
IIT Kharagpur	17	15	11	0	4
IIT Delhi	25	21	19	2	0
UOR	22	21	19	2	0
JU	32*	25	23	1	1
Total	96	82	72	5	5

*In all there are 45 women faculty, 32 of them have Ph.D. degree.

2.7 Processing and Analysis of Data

The questionnaires and the biographical information were coded and data were entered in the computer. In the case of interview schedule, that used uncoded items and questions, content analysis of the responses was done to yield categories of responses to be coded. For example, consider the interview question, 'Why have there been no women Deans?' Based on the responses the following categories were used for coding:

1 Few women faculty

2 Lack of ambition

3 Problem in interacting with male students

4 Family constraints

5 Discrimination or gender politics

6 Problem of interacting with lower staff

7 Other

8 Don't know

Data were analysed using descriptive statistics (such as means and standard deviations) and multivariate analysis (using SPSS). During the processing of the questionnaire, scores were reversed for some questions. This gave the advantage of showing a higher value of mean score for higher degree of agreement, a desirable strategy from the point of view of effective communication. However, at the time of asking the question it appeared more realistic to use scores for agreement as in the questions.

2.8 Conclusion

The study was conducted in the institutes, which are known for their strong tradition in science and engineering. Since there are few women scientists in these institutes, all of them were contacted for the purpose of data collection. Method of triangulation has been adopted in the study of women scientists to collect the data. The triangulation of various methods was intended to provide a holistic picture of the issues facing the women academic scientists. The different methods of data collection have their own advantages and disadvantages that have been highlighted above. It was found that in the studies such as the present, a combination of questionnaire and interview methods could be quite useful for obtaining a more complete picture of the reality. The social background and academic profile of the respondents and general environment of

academic science in India forms the subject matter of the next chapter. This will help us to identify the social and professional milieu of the respondents.

CHAPTER 3

SOCIAL AND PROFESSIONAL MILIEU OF THE RESPONDENTS

3.1 Introduction

This chapter describes the background and professional characteristics of the respondents. It also looks at the nature of academic science in India and, teaching and research activities of academic scientists in the developing countries. This is followed by a discussion of the problems faced by academic scientists in general and by the women scientists in particular.

The data show that in general the respondents belong to an upper caste, middle class, Hindu background. Although all of them did not have very highly educated parents but in the family they had an atmosphere of encouragement. Many of the respondents have distinguished themselves in professional matters and are quite active in research.

3.2 Social Background of Respondents

This section describes the background characteristics such as age, economic status, the size of family of procreation and the family of orientation, marital status, and education of parents and siblings.

3.2.1 Religion

All the respondents except two are Hindu. One is a Muslim and another Christian. This is not surprising considering the low level of education among Muslim women and the low proportion of Christians in the population.

3.2.2 Age

Table 3.1 presents the distribution of respondents by age. It clearly shows that the majority of the respondents (51.3%) are below 45 years. The modal category of the distribution is 35-40 years. This indicates that they must have completed their graduation in science or engineering during the late 1970s or early 1980s. It confirms other researches (see Chapter 1) that show a trend of higher number of women entering this field during the last 20-25 years.

Table 3.1: Distribution of Respondents by Age

Age	Frequency	Percentage
30-35	8	10.3
35-40	19	24.3
40-45	13	16.7
45-50	13	16.7
50-55	14	17.9
55+	11	14.1
Total	78	100

3.2.3 Marriage and size of household

About 80.5% (62) respondents are married, 15.6% (12) are single, 2.6% (2) divorced and 1.3% (1) widowed. Thus, 65 respondents have been married at some stage of life, which confirms the universality of marriage in India. The family size is characteristic of the members of upper or middle class of Indian society. The average number of siblings of the respondent is 2.9, while the average number of children of the respondents is 1.3. This shows a preference for a fewer number of children among

present generation families compared to the earlier generation. About 37% (29) of the respondents were brought up in joint families and the rest in the nuclear families. Among respondents the percentage living in joint families has fallen to 20.5% (16). The nature of joint family varies. Of those respondents living in a joint family, five are staying with their parents, eight with their in-laws, or families of their children.

3.2.4 Class background

Most of the respondents belonged to a middle class background. None of the respondents belonged to the Other Backward Caste or Scheduled Caste and Scheduled Tribe. About 83% (65) of the respondents had father either in the government service (38) or in professions (such as doctor, engineer, lawyer or lecturer were 27). Fathers of only 6 respondents worked in private service. Among others, five were in business, one worked in agriculture and one was a mechanic. On the other hand, about 75.7% (59) respondents' mothers were housewives. Only 5.1% (4) respondents' mothers were in government service and mothers of the rest 19.2% (15) were professionals.

About 39% of the respondents were born in metropolitan cities (such as Delhi, Bombay, Madras and Calcutta), 7.7% in the State Capitals other than metropolitan cities, 48.7% in the other urban areas, two were born in a suburban town and two were born abroad. The majority, 51.3% (40) had spent most of their lives in metropolitan areas, 3.8% in capital cities (other than metropolitan cities) and 44.9% in other urban areas. Thus not a single respondent had a purely rural background.

A majority, that is 53.3% of the respondents, had been educated in English medium schools and the rest in the vernacular medium. For a majority of the respondents early education was done in private schools and it may be noted that

private schools are mostly English medium and are more expensive than government schools. The above facts indicate that majority of the respondents came from the elite class of Indian society.

3.2.5 Education of parents

Women scientists constitute a socially mobile group. They were more educated than their father is and much more educated than their mother. Mothers of 51.2% (40) respondents were not graduate. Their education was only intermediate or less. There were five respondents whose mother had no formal education at all. Mothers of 21.8% (17) respondents were graduate and of the rest (21) were postgraduate. Among the latter only six mothers had degrees in science, engineering or medicine, others had a degree in arts. Not a single mother had a doctorate degree. The educational achievement of the respondents was a major advancement in status over the previous generation of women.

Fathers of the respondents, were better educated than the mothers but they too were not usually as highly educated as their daughters. Only 18% (14) fathers had education less than graduation. About 17% (13) fathers had bachelor's degree in engineering or medicine, 38% (30) were postgraduates and 17% are graduates. Fathers of only 10% (8) respondents had a doctorate degree.

3.2.6 Education of the siblings

A comparison of the educational achievements of the brothers and sisters of the respondent indicates that the respondents usually came from families where education

was highly valued. Table 3.2 presents the frequency distribution of brothers and sisters by educational achievements.

Table 3.2: Comparative Educational Attainments of the Siblings of the Respondents

Level of education	Brothers		Sisters	
	No.	Percentage	No.	Percentage
Less than graduation	0	0.0	1	1.7
Graduation*	12	20.0	6	10.5
Post-graduation*	5	8.3	16	28
Post-graduation + diploma or professional degree	2	3.3	4	7.7
B.Tech./B.E./M.B.B.S.	13	21.7	2	3.5
B.Tech.+ diploma or professional degree	18	30.0	7	12.3
Ph.D.	10	16.7	21	36.8
Total	60	100	57	100

(* Graduation and post-graduation in humanities, social sciences and pure sciences)

Table 3.2 indicates that more brothers than sisters are engineers. This is probably because in the Indian society engineering is preferred for men. Sisters outnumber brothers in post-graduation, in a diploma or professional degree above postgraduation, and in having a Ph.D. In case of the graduate degree, brothers outnumber sisters. However, the small number of cases would not permit drawing inferences of a general nature. Overall, the sisters of the respondents generally had a high educational level and their numbers were negligible only in engineering.

In general, the parents were quite supportive of their daughter's education though they may have had some misgivings at times. This is particularly evident in the responses to the following question: 'Did your parents have different expectations from you and your sisters compared to your brothers?' About 31% (24) said 'yes' but the majority, 51% (39) said that no such distinction was made. About 18% (14) of the respondents had no brother. Out of 39 respondents who said 'no', in at least five cases, there were greater expectations from them than from brothers, because they were perceived to be more brilliant. In another five cases, parents encouraged the daughters to be at the top, and in 7 cases parents wanted higher education for their daughters. Among the rest (22), there was an expectation that the daughters too should stand on their own feet but there was no specific career in mind: what they achieved was 'extra', that is over and above what was expected from them.

Out of 24 respondents who said that parents had greater expectations from brothers, 8 were from science departments; their parents did not prefer engineering for daughters. Since it was considered men's domain only brothers were encouraged to become engineers. The rest said that there was an element of compulsion for brothers to do well and they were encouraged to take up industry jobs. There was no such compulsion for the respondents or their sisters. This reflects patrifocal concerns of society. Also, parents did not prefer their daughter joining an educational institute, which was too far from home. This was largely due to the concern of the parents for their daughters' physical safety.

3.2.7 Selection of the spouse

Traditionally, Indian marriages are 'arranged', that is, spouse for a boy or a girl is selected by the parents. They are also hypergamous, that is, a boy from higher status is selected for the girl. Earlier the criteria for status were caste, sub-caste, gotra, wealth and social status, and groom of the age higher than that of the bridegroom was selected. The system preserved and legitimated male authority. With modernisation of society, while the traditional criteria remained unchanged, a new criterion of education was added. Thus, the expectation is that at the time of marriage a man should have higher educational qualifications than the woman. Higher education among girls restricts the conjugal choices of spouse since it means selecting an even more highly qualified groom.

As mentioned earlier, 80.5% (62) of the respondents were married, 15.6% (12) were single, 2.6% (2) were divorcees and 1.3% (1) were widow. Among those who were single, four were between 34 and 39 years of age, while three were in their 40s, and five in their 50s. Their ages were well beyond the Indian age of marriage for girls, which does not exceed the late 20s even in cities where it is higher.

In case of eight respondents that were single, parents had made efforts to find a groom but following problems arose and their marriages could not take place:

- respondents themselves were against the marriage (4 cases)
- could not find an equally qualified groom (2 cases)
- were not able to give dowry (1 case)
- a match of respondent's choice could not be found (1 case)

Among the four who did not want to marry, three had a perception that family and career are difficult to combine, and one desired to live alone. There were also four respondents whose parents did not attempt to find a groom. Father of one respondent died and the family responsibility fell on the respondent herself. Consequently, she remained unmarried. In the other three cases, parents accepted the decision of the daughter not to get married. These respondents also felt that they will not be able to combine family and career. As one respondent put it, 'family life makes career difficult'. This shows that concern for career could affect the possibilities of marriage and satisfactory family life among some women.

There is a general social perception that combining family and career, and to be able to do justice to both is a stupendous task for a woman to achieve. Yet majority of the respondents felt that this is a myth. Undoubtedly, while a man also devotes time to family and career, woman's association with the family is more due to her reproductive and nurturing roles. However, it affects career only for a short period. Today when the average family size has declined to post-transitional level between 1 - 2, women have a long period of working ages that they can easily devote to non-familial works.

It appears that majority of those remaining single, did so out of choice. This might be seen as a challenge to the traditional value system. This is further illustrated in the case of those who are married. Among the 62 married respondents, 50% (31) marriages were not arranged, that is, they chose their own spouse; 5.2% (4) were a mixture of arranged and self- choice and the remaining 48.4% (30) marriages were arranged. The arranged marriages often bring problems to the woman and her family due to hypergamous marriage system, dowry and the overall dominance of groom's

side, which is again a reflection of the patrifocal values. Those who are married were asked if their parents had problems in finding spouse for them. About 26% (17) of the married respondents replied in affirmative, 29%(19) said there was no problem and 41.5% (27) said that there was no need for the parents to attempt to find a spouse, since, they found their match before their parents started looking. To put it differently, 56.7% (17 out of 30) arranged marriages encountered problems. Out of 17 such marriages, 15 faced problems mainly due to difficulty in finding an equally qualified spouse. Two such respondents said that high educational qualification is rare in their caste or community itself. One reported dowry problem and one faced problem because of her dark complexion. According to this last respondent, her parents went through a very hard time in getting her married because she was 'too educated' and had dark complexion; when she started working, people insinuated that her father did not want her to get married because of the money brought home (which a daughter's family has to forego once she gets married). Ironically, among the highly educated and professional respondents as in this study traditional customs of marriage involving giving gifts from bride's side to groom's side, was followed. 80% (52) marriages involved this exchange (dowry) and only 20% (13) marriages were without it. The latter were performed in the non-traditional way.

3.2.8 Age at marriage

Social movements of the 19th and early 20th centuries emphasised raising the minimum age of marriage for girls. Sarda Act of 1929 set this age at 14. In 1976 it was raised to 18 years for girls and 21 years for boys. As opportunities for education increased, marriages among women were delayed to accommodate higher education.

Today states like Kerala that have the highest level of female literacy also have the highest age of marriage among females. Education has also brought about an increased female assertiveness and preference for nuclear families. It must be mentioned that in all circumstances there is a best age group for marriage. There are fewer problems if marriages are arranged in this age group. Recent studies have shown that most fathers in India would like to arrange their daughters' marriage in their late teens or early twenties, since it would become increasingly difficult to find grooms who should be older than their daughters. With increasing age it would be still more difficult to find groom more educated than the girl (Sadagopan and Kumar, 1979; Steve Derne, 1994).

In the sample of highly educated women in this study age of marriage was quite high. Maximum number of respondents married between the age of 25 - 29 years. There is no respondent marrying below the age of 20 or above the age of 35. Table 3.3 shows the number of women marrying in different age groups:

Table 3.3: Distribution of Respondents by Age at Marriage

Age at marriage (in years)	Number	Percent
20 - 25	26	38.8
25 - 30	29	43.2
30 - 35	12	18.0
Total	67	100

Table 3.3 shows that 18.0% of the respondents married at the age of 30 years and above, which is a very high age of marriage. Overall, 61% of the respondents married at the age of 25 years and above. The median age of marriage is 26.3 years.

However, a substantial percentage (38.8%) of respondents married below the age of 25 as well. For them a career in academic science began after marriage. This aspect is discussed further in chapter 6.

3.2.9 Changing nature of age hypergamy

In the hypergamous marriages in India, the man is usually older than the woman. This legitimates and furthers the structure of gender authority, typical of the patrifocal system. No difference, less or negative difference implies greater companionship and equality in relationship. The study of difference in ages between husband and wife in our sample presents a mixed picture with a tilt towards change rather than a continuity of tradition. Table 3.4 presents the distribution of respondents by difference in age of husband and wife.

Table 3.4: Distribution of Respondents by Difference in Age of Husband and Wife (in years)

Difference in ages (Husband's age - wife's age)	Number	Percent
-1 and Below	2	3.1
0	15	23.4
1-2	14	21.9
3-5	16	25.0
6 and above	17	26.6
Total	64	100

In the above table, the logic behind the groupings is that a negative difference shows a radical break from the traditional norms. Existence of no difference implies a

lack of age hypergamy. Difference of one and two years is a rather small difference that also shows the declining age hypergamy. Difference of three to five years is a moderate difference and a difference of 6 and above is very high. There were two cases in the first category. In one case the respondent was 7 years older than her husband. In the other case she was 3 years older. The maximum difference in the last category has gone up to 12 years, but there are 8 respondents with a difference of 6 years, and 9 respondents with a difference from 7 to 12 years.

The percentage of respondents with a negative and zero difference is 26.5%. At the same time difference of 6 years and above is also the same (26.6%). The reason probably being that those who entered into love marriages were able to get spouses with less age difference but in case of arranged marriages, parents probably found it difficult to find grooms of the same age with equally high qualifications. Thus, negative difference and zero difference cases are more in love or love-cum-arranged (36% of non-arranged) than arranged type (17% of arranged). Also, a difference of 5 years and above is found more (about 45%) in arranged marriages and only 21% in love-cum-arranged marriages.

3.2.10 Educational hypergamy

While the presence of negative difference and zero difference in the age of marriage presents a break from age hypergamy among some respondents, the break from the usual educational hypergamy is more vivid. Needless to say, higher education among women has enormous potential for challenging patrifocal ideology by granting greater freedom to women to choose husband of their choice. Table 3.5 shows the distribution of respondents' husbands according to educational achievements.

Table 3.5: Educational Qualifications of Respondents' Spouses

Educational Qualification	Number	Percent
Graduation*	2	3.0
Post-graduation*	4	6.1
Post-graduation + diploma or professional degree	6	9.1
B.Tech./B.E./M.B.B.S.	7	10.6
B.Tech. + diploma or professional degree	14	21.2
Ph.D.	33	50.0
Total	66	100

(* In humanities, social sciences and pure sciences)

Table 3.5 shows that 50% of the spouses are not doctorates. Two are simple graduates. The difference in educational qualifications exists in both arranged and non-arranged marriages. Thus, among 6 spouses who are graduates and post-graduates in the humanities, social sciences and pure sciences, marriages of 3 are arranged and of 3 non-arranged.

3.2.11 Educational decisions of the respondents

In India, the decision to pursue science and engineering is a family decision, particularly in the case of girls (Mukhopadhyay, 1994). However, 54.5% (42) of the respondents said that they themselves made a decision to pursue science or engineering (Table 3.6). Among others 15.6% (12) said it was a family decision; 6.5% (5) said some relative made the decision; 15.6% (12) said that father made the decision and 7.8% (6) said that mother made the decision. It is also observed that the number of respondents making their own decisions increased with the rise in the level of their

education. Also, in case of which branch of science or engineering should be selected, the institute to be joined at the postgraduate level, or taking up a job as an academic scientist more than 70% respondents made their own decision. Even in other decisions such as the choice of science at the school level, or the choice of institute at the undergradute level more than half of the respondents decided themselves. Thus both the background and assertiveness among the respondents helped them to achieve high academic position at a reputed institute of science and engineering.

Table 3.6: Distribution of Respondents According to the Persons who made Decision Regarding Education

Type of educational decision	Father	Mother	Others	self	Family	Husband	Total
Choice of science or engineering in school	15.6	7.8	6.5	54.5	15.6	0.0	100
The branch of science or engineering to be selected	15.6	2.6	5.2	70.1	6.5	0.0	100
The institute to be joined i. For B.Sc/B.Tech	27.3	6.5	2.6	57.1	6.5	0.0	100
ii. For M.Sc/M.Tech	13.0	2.6	3.9	70.1	5.2	4.2	100
iii. For Ph.D.	7.9	1.3	3.9	80.3	2.6	3.9	100
Taking up job as an academic scientist	3.9	2.6	0.0	81.8	2.6	9.1	100

Mothers seem to have influenced the decision only in exceptional circumstances. A respondent was encouraged by her mother to go for a science career because her father was a sportsman and was not involved with the family. In another case, the respondent lost her father at an early stage and mother had to make all decisions. Yet, mothers did have substantial influence on the respondents' motivation. As one respondent said,

From our childhood we knew that we would have to get a higher education. My mother influenced me maximum even though she was not a scientist.

In general, parents saw advantage of giving higher education to their daughters. As many as 89% (68) respondents said that parents were supportive of their higher education. In 10% (8) cases only, parents did not prefer higher education and in one case respondent had lost her parents quite early. Parents who supported higher education felt that it would make their daughter 'self-sufficient' or 'independent' and provide self-satisfaction. Of course, they too had not visualised that their daughter would reach such heights. About 61% respondents said that their parents wanted self sufficiency for them, 18% said that parents encouraged them to take up higher education 'for the sake of education', 10% parents were highly ambitious about their daughters' education and wanted them to be successful in life.

Apart from the eight cases where parents were not supportive, some other parents also saw some negative points of higher education though they were supportive. About 39% (30) of the respondents said that the parents foresaw some negative effects. Out of 30, the parents of 25 respondents were worried about finding an equally qualified groom. The rest felt that higher education in science would be stressful, that it would require staying away from home, and that problem of getting a job at the same place as the husband, might arise.

3.2.12 Influence of relatives with science background on the decision to pursue career in science

In this study an attempt was made to find out if the respondents had any close male or female relative in science that influenced them to take up this career. About 47%

(37) respondents had a close woman relative in science but only 40.5% of such respondents were influenced by them. The influence of male relatives in science was greater. About 72% (56) respondents had a male relative in science and 68% of such respondents were influenced by them. This shows that respondents were more influenced by male relatives in science than by female relatives. The greater influence of male relatives is probably due to the dominance of men in public sphere: since public sphere is primarily male sphere, their opinions related to this sphere carried greater weightage than those of women. Another reason could be that socialisation in patrifocal society accords greater respect to men and their opinions than women. Further, while among the women relatives, influence of sister is the most powerful influence, among the male relatives, influence of father is most powerful.

3.3 Professional Profile

3.3.1 Ph.D. degree - granting Institution

The institution from where an individual obtains a Ph.D. indicates three things. One, it indicates the quality of the thesis. National level institutes are more respected than other institutes and the quality of research work done here is usually expected to be better than at the state institutes. Second, if an individual is employed at the place where he/she obtained the doctorate, it affects the power dynamics in the department and the institute. Inbreeding is considered an undesirable feature in academic circles. It stops new ideas and new ways of thinking. Third, if the degree has been obtained from a university abroad, it may show that the respondents are geographically mobile. Moreover, there is a belief that foreign degree is associated with greater exposure to international research and has some minimal standards.

Table 3.7 shows the distribution of respondents according to the institution from which they obtained a Ph.D. degree. It is notable that majority of the respondents obtained their Ph.D. degree from the institute where they are currently working. Sixteen respondents got their degree from other national level institutes and only 10 from abroad. 10 respondents have degree from other universities in India. One reason why most of them have degree from their own institute is that about 22 joined as a research associate. Parents usually did not prefer their daughters joining an educational institute, which was too far from home. This is largely due to security concerns of their parents for their daughters.

Table 3.7: Distribution of Respondents According to the Institute from where they Obtained Ph.D.

Institution of Ph.D. degree	Institution employing the respondents				Total
	IIT Kharagpur	IIT Delhi	UOR	JU	
National level institutes other than where employed	5	7	4	0	16
Institution where employed	7	5	13	16	41
Universities in India	0	2	1	7	10
Universities abroad	2	5	1	2	10
Total	14	19	19	25	77

*National level institutes include the IITs, Jawaharlal Nehru University, Indian Institute of Science, Bangalore.

The table shows differences among the institutes also. About 68% respondents of UOR, 64% from JU and 50% from IIT Kharagpur have done their doctorate from the institute where they are presently employed. Only IIT Delhi has one-fourth respondents who did their doctorate there. IIT Delhi respondents have done their Ph.D. more from

other national level institutes and abroad. This also indicates that those who do Ph.D. from abroad or national level institutes in India have the first preference of joining IIT Delhi, which is located in the capital city. IIT Kharagpur, UOR and JU being located in non-capital cities fail to attract the best because of locational disadvantage. This also shows a high degree of inbreeding in the two universities and at IIT Kharagpur. In theory, academicians have generally been against inbreeding because it often leads to favouritism and politicking.

3.3.2 Professional status

Designations of professor, associate professor, assistant professor and lecturer exist at the IITs and UOR, and, those of professor, reader, senior lecturer and lecturer at the JU. The grades of professor and reader at JU correspond roughly to those of professor and associate professor at the IITs and UOR; grade of lecturer at the IITs and UOR has been merged with those of lecturer and senior lecturer at the JU. The following table shows the designation of the respondents when they joined the profession and their designation at the time of the study.

Table 3.8: Frequency Distribution of Professional Designation of the Respondents

Designation	Number of respondents with designation			
	On joining		Now	
	Number	Percent	Number	Percent
Research associate	22	28.6	0	00.0
Lecturer/Senior lecturer	44	58.4	15	19.5
Assistant professor	9	11.7	24	31.2
Reader/Associate professor	1	01.3	18	23.4
Professor	0	00.0	20	25.9
Total	77	100	77	100

The above table indicates that 28.6% of the respondents joined as research associate. These respondents did their doctorate from the institute where they are presently employed. More than half joined as lecturer. One respondent joined as a reader since she taught elsewhere before joining the institute. The table also shows that about half of the respondents are at the lower rungs of the professional ladder, that is, lecturer, senior lecturer and assistant professor. Only one-fourth of the respondents hold the position of professor, i.e., the highest position in academics.

3.3.3 Travel, publications and recognition

All faculty members participate in seminars, write research papers for journals and conferences, and publish books. Only 3 out of the 78 respondents did not participate in any conference or seminar. They are functioning mainly as teachers. Table 3.9 gives a per year average of the research output of the respondents. The data was collected for the last three to five years from all respondents to standardise the information. Table 3.9 shows that the average annual output of journal articles of women scientists is 1.66. This is higher than the average annual productivity of 1.1 at Madras University reported by Subrahmanyan (1998). On an average, annual participation in national conferences, seminars and workshops (1.6) is more than in international ones (0.4). In general, average number of publications in engineering is lower than in science. Engineering faculty do not attach as much weight to publications as the science faculty. The former attaches higher value to sponsored projects, design and consultancy, and get lesser number of research students than the latter. Thus, the average annual publication in the last five years for those in science is 2.04 and for

those in engineering is 1.26. The average number of book chapters published till December 1999 was 0.47.

Table 3.9: Average Annual Research Output of the Respondents

Research activity	Average (per year)
Seminars, conferences and workshops attended in India in last 3 years	1.60
Seminars, conferences and workshops attended abroad in last 3 years	0.40
Papers presented in national conferences in last 5 years	0.96
Papers presented in international conferences in last 5 years	0.62
Publications in journals in last 5 years	1.66

Table 3.10 presents the average research output of respondents separately for the four institutes. It is evident from the table that the

Table 3.10: Institute-Wise Average Annual Research Output of the Respondents

	Average (per year)			
Research activity	IIT Kharagpur	IIT Delhi	UOR	JU
Seminars, conferences and workshops attended in India in last 3 years	1.17	2.00	1.20	1.40
Seminars, conferences and workshops attended abroad in last 3 years	0.40	0.67	0.16	0.29
Publications in journals in last 5 years	1.96	1.72	0.92	1.78

participation of the respondents in conferences, seminars and workshops within India and abroad is maximum at IIT Delhi. Average number of publications of the respondents is highest at IIT Kharagpur. Within the limitations of the sample size these

differences support the postfeminist argument that women's productivity is conditioned by context.

Several respondents have won national and international recognition. One of the respondents is a Bhatnagar award winner. One respondent has won the Young Scientist Award of the Indian National Science Academy (INSA). One respondent is a recipient of the UN silver medal, 12 respondents have served as visiting scientist or received faculty fellowships abroad. Two respondents have developed their own patents. At least five have received Best Paper awards. Many of them have obtained scholarships in India or abroad for research.

3.4 Nature of Academic Science in India

The Indian scientific community has been characterised as 'middle range community' (Krishna, 1997). India is not a 'metropolitan' scientific power but Indian science cannot be called a 'peripheral science' either. India has the third largest human resource in science and technology in the world. Her scientific output is 64% of the total Third World scientific output. It has also been able to generate sufficient professional infrastructure in terms of the science academies, scientific societies, journals, universities, specialised research institutions, institutionalisation of new scientific disciplines, etc.

However, there is a subtle domination of the western science on Indian science. Scientific Citation Index 'undervalues and under-represents Third World science....' (Krishna, 1997, p.255). 'Good science' has come to mean Western science. As a result, problems chosen by the Indian scientists are removed from Indian realities. Indian scientists look forward to publishing in international journals and downgrade

Indian journals (Paintal, 1990). The peer review system in Indian journals is not as rigorous as in the West, mainly due to small size of peer groups in their fields of specialisation (Haribabu, 1991). In this study, about 55% of the respondents agreed that there is a lack of proper review system in the Indian journals.

It is widely recognised in India that there is a need for active interaction between science, technology, industry and market to increase the impact of science on society and to uplift the nature of Indian science in general. In this study, About 66% of the respondents agreed that there is little crossflow of information from the research sector to the industrial sector. About 62% respondents said that there is a paucity of government funding for research and development activities. About 64% of the respondents said that there is a lack of government policy to promote research in industry.

Apart from this, there is a need to produce scientific temper in India. A greater respect for scientific thinking (objectivity) has to be consciously cultivated. In pre-British India, education meant mainly learning of the scriptures and obedience to the 'guru' or teacher. Questioning was discouraged and technical knowledge remained in the hands of the guilds, where the sons of the craftsmen were trained in the hereditary trade (Thapar, 1966). Craftsmen did not enjoy high status and were lower in social hierarchy. It was the British government, which laid the foundation of modern science in India. But the colonial scientific structure discriminated against Indian scientists and gave no encouragement to Indian research students. Indian scientific community grew largely as a part of the emerging nationalist consciousness. Several professional associations and journals emerged in the pre-independence period. In the post-

independence period, under Nehru's leadership there was considerable growth of infrastructure. The scientific elite identified with Nehru's vision of science and there was growth of science - politics nexus. The expansion was concentrated in the science agencies while research in academic, university sector was not given much importance. Bureaucratic procedures in government departments of science, economics, industry and commerce made co-ordination between different actors in the field of science and technology difficult and its networking with the market and industry restrictive (Krishna, 1997).

In the present scenario, the users of science, that is, the businessmen, politicians and civil servants have a disregard for Indian science and scientists (Shiva and Bandyopadhyay, 1980). This is brought out in this work as well. The respondents felt that society does not give sufficient importance to research. About 58% respondents felt that there should be greater recognition of merit, and more weightage and encouragement for research should be given by the government and the society in general. According to a respondent in Institute D, 'a person doing Ph.D. is often seen by people as an unemployed youth filling up his/her time'. About 10% respondents felt that education system does not cultivate an analytical outlook or a questioning attitude.

According to 54.5% respondents a 'good quality research' should have application orientation or relevance to society. This confirms the findings elsewhere on women scientists. For instance, Rosser, director of women's studies and professor of family and preventive medicine at the University of South Carolina, has found that women tend to be interested in a problem or a question if it has some context or social relevance, or the solution produces some benefit (Holloway, 1998).

About 65% respondents felt that research in India is not as good as in the West. It can be improved through better facilities, greater recognition of merit and greater co-ordination between researchers, and greater interaction between researchers and industry (in the descending order of response). Encouragement for research is important since the students of science and engineering are opting for highly paying software jobs than research. A few respondents also felt that researchers need more faith in their capabilities and greater national outlook.

Opportunity to practice science varies across nations. Science as practised in the club of 'centre' nations is given greater weightage than that in the 'periphery'. Inequality prevails within the nations also. In India, the full time scientific agencies such as Department of Atomic Energy, Council for Scientific and Industrial Research, etc. receive greater attention and larger funds for higher research in their national laboratories than the universities. Further, urban universities in metropolitan cities such as Delhi, Kolkata, Chenai and Mumbai receive greater support in setting up infrastructure for teaching and research than the universities in other cities. Similarly, the Indian Institutes of Technology (IIT) at now six places have drawn greater support from the government than the regional engineering colleges (Krishna, 1997). According to one respondent in Institute A, 'in getting funds from government and its agencies, it is important where one is applying from; applications from elite institutions are given more preference than others'.

This scenario of science in India has some implications for women scientists in the country. First, the domination of Western science implies greater recognition for research in which the West is interested. Indian women scientists, in general, are

interested in those problems that have relevance to our society. Such research issues will not be published in international journals and may not get any other form of international recognition since they have no relevance to the Western society. This indirectly harms the career of those women scientists working on problems with social relevance. Second, while women are late entrants in science, their representation at top levels of administration has also been minuscule. Thus, the nexus between science and politics in the post-independence period has ensured male dominance in the system. For instance, cumbersome bureaucratic procedures required in getting projects, funds or any other technical assistance are difficult for a woman to fulfil since such procedures may require running around government offices to get the work done. Women scientists lack political contacts and time constraints. This has been shown in chapter 6. Third, a lack of facilities has a greater effect on women than men because men compensate such a lack through interaction with other researchers. Women are not very active in their informal interactions. This point is elaborated in the fifth chapter.

3.5 Society's Perceptions about Science

Patrifocal ideology and value systems influence society's perceptions about science. This ideology is responsible for the prevailing stereotypes regarding women in science. Science and engineering are perceived as a male vocation. The existence and effect of the stereotypes are clearly brought out by a set of questions on sex role attitudes regarding science. Responses to these questions were obtained on a five-point scale ranging from 'strongly agree' to 'strongly disagree'. Table 3.11 presents the distribution of responses. The table shows that in the perception of the majority of the respondents, stereotyped notions do exist.

Table 3.11: Percentage of Respondents Reporting Existence of Stereotypes

Statement **Many people think that:**	Strongly agree	Agree	Partly agree	Disagree	Strongly disagree	Total
Women cannot be successful in science or mathematics	11.7	39	23.4	13	13	100
To do science and engineering is to be less of a woman	10.5	35.5	29	18.4	6.6	100
A woman has less analytical ability than a man	6.5	33.8	32.5	15.6	11.6	100
Inability to solve a problem is ascribed to the quality of being a woman	6.5	27.3	28.6	26	11.7	100

In Table 3.11, the percentage of respondents who agreed or strongly agreed was 40.7%, 46.5%, 40.3% and 33.8% respectively for the four statements. Percentage who disagreed or strongly disagreed is much less except for the last statement. A respondent in Department of Mathematics from Institute B said:

> If a woman goes for doctorate in mathematics, people think that there is something wrong with such a woman; that she is less feminine; they think that she is unapproachable, arrogant and cannot think of anything else except maths; she is not treated as normal.

The data on gender role stereotypes was subsequently analysed separately for respondents in science and engineering departments. In case of the first statement, while 41.8% of those in science strongly agreed or simply agreed, those in engineering who agreed or strongly agreed were as many as 60.1%. Within the limitation of sample size, this indicates that women in engineering have faced greater biases.

3.6 Problems as a Student

Indian society has lower expectations from women. Our educational system, including teachers, also reflect social stereotypes in their behaviour. This leads to several problems among women students in science.

Society is unable to visualise a woman being first in competitions, especially in the field of science. According to one respondent:

> In the final year of the school, I topped among all the schools in the city. The boys' schools did not like it and I received lot of junk mails. I faced harassment and only the support of my parents helped me in this crisis.

Another respondent said:

> I got a gold medal in college. Some teachers thought that I being a woman could not do it and they passed negative comments. In my undergraduation I was always under the pressure to prove myself.

Some respondents also reported that teachers discriminated against the girls and favoured male students. Some male teachers consciously avoid interaction with women students even during the teaching session. One respondent reported that there was one male teacher who always talked to her while looking at the floor. Sometimes the teacher may be too nice to the women students. Both the situations have gender connotations and therefore irked the respondents. Some respondents said that being few in the class of boys brought lot of attention which was disliked by some and ignored by others.

3.7 Some Implications of Social Perceptions

Sex role stereotypes exist in all societies. Majority of the respondents believed that, overall, while Indian women enjoy respect in Indian society, the major disadvantage to Indian women scientists compared to their Western counterparts is that in India they have relatively less freedom. Their social roles are more rigidly defined and there are larger social obligations on women than in the West. Childcare facilities in the institutes and outside the institutes are minimal. Absence of continued water supply in some areas, and absence of facilities including cooking facilities, and proper

transportation compound domestic problems of Indian women. In work situation, fieldwork is a problem for an Indian woman since it is not secure.

There is a dearth of women role models and mentors. About 43% (33) of respondents did not have any role model at any point of their life. Only six respondents had a woman scientist as a role model, ten had Madam Curie and two had their mothers as a role model. About seven named famous women of modern India as their role model, such as Indira Gandhi and Kiran Bedi. The rest (19) had some man as a role model.

However, respondents feel they are as suited as men to perform well in science. According to the respondents, the main ingredients to succeed in science are hard work, creativity and a sharp intellect (in descending order of importance) as shown in Table 3.12. In the table a higher value of mean indicates higher degree of agreement on a scale of 1 to 5.

Table 3.12: Average Agreement on the Traits Required to Succeed in Science

Item	Average	S.D.*
Hard work	4.87	0.34
Creativity	4.50	0.63
Sharp intellect	4.40	0.90
Communication skills	4.14	0.77
Adaptability/flexible approach	4.12	1.11
Competitive spirit	4.05	0.62
Ability to attract students for research	4.04	1.08
Good interpersonal relations	3.86	0.99
Ability to bring funds	3.80	0.89
Contacts	3.54	0.96
Foreign degree	2.67	0.87

* Standard Deviation

After identifying what factors are needed to do science well, a question arises whether women are seen by society to be as good as men on these factors. According to

71% of the respondents, women are seen by society to be harder working than men. Women are seen to have a more flexible approach than men. More than 65% believed that both men and women are perceived to have creativity and a sharp intellect. But women are perceived to be lagging behind men in competitive spirit, an ability to attract students for research, ability to attract funds, and contacts. Among other traits, such as communication skills, interpersonal relations, etc. no differences are perceived between men and women. Though contacts are given tenth rank in the order of importance, interviews indicated that contacts are quite important for success.

Thus, according to the respondents, the first three essential qualities required for success are hard work, creativity and sharp intellect. Women are not seen as lacking in any of them. In fact they can work harder than men. This shows that in the perception of women scientists they have the essential ingredients for the making of a successful scientist. Their problems arise not due to deficiency of these important factors but due to certain environmental factors, which shall be discussed in the next chapters.

3.8 Conclusion

In sum, the data on social and professional background of respondents lead to three major conclusions. First, the women respondents represent a highly mobile group with respect to educational achievements. They are much more qualified than their parents, siblings and husbands. They have been fairly independent in terms of decision making regarding their career and were fortunate enough to receive positive backing of the parents for their education. The facts, such as, some respondents opted to remain single, almost half of the respondents married according to their choice, age at marriage is quite high, and age-and-educational hypergamy is on decline indicate a process of

social change with significant consequences for gender roles. Second, scientific profession and society are deeply intertwined. Social stereotypes consider women unfit for scientific profession. It is considered a man's domain. Such stereotypes infiltrate the workplace as well and disadvantage women in the profession. Third, there is an inequality in science. There is a relationship of dependency between the science as practised in the West and as practised in the Third World countries including India. Within India too institutions practising science have been treated unequally. Within the institutes there are particularist elements in the practice of profession that affect women. This issue is explored in the next two chapters.

CHAPTER 4

THE FORMAL ENVIRONMENT

4.1 Introduction

The institution of science is supposed to have its own ethos - universalism, communism, organised scepticism and disinterestedness (Merton, 1942). Studies in sociology of science have examined this ethos in the practice of science. These studies have paid particular attention to the ethos of universalism. On the basis of such studies it has been suggested that the system of allocation of recognition and rewards in science is far from being universalistic (Kuhn, 1970). It is interesting to examine to what extent inequality of rewards and opportunities in science are related to sex. Among the scientists the opportunities to contribute to science are marked by a high degree of inequality. Scientific productivity varies according to training facilities, resources, cultural capital, and informal access to information about current developments at the frontiers of science (Mulkay, 1980). Recognition and rewards are highly stratified (Zuckerman, 1988).

Further, from the perspective of sociology of profession, science is a profession in its own right. From this perspective, every profession has its own 'habitus', which is made up of 'complex social processes'. It has two aspects: 'technicity' and 'indeterminacy'. 'Technicity' is the rule-governed part of the habitus. It is the formal aspect of work, where, the technical skills and knowledge behind the skills are specified, and the rules are codified. At the level of everyday practice, professions tend to form 'occupational communities' (Atkinson and Delamont, 1990). In these communities 'indeterminate',

uncodified and informal aspects are important in the actual performance of the roles. Mere professional knowledge or technical skills are not enough for success. The individual also learns to behave in ways regarded as 'professional'. The status of women in science has to be judged by studying both the formal organisation of work and the informal elements involved in the work performance. While the former requires the study of organisation structure and norms, the latter requires the study of the level of participation in variety of scientific processes, such as informal communication, networking, and group activities. This involves a study of manifest and latent aspects of the profession.

The formal organisation of work and the habitus of the profession are intertwined. Together they determine the success of the practitioner in establishing oneself and in gaining acceptance and recognition. An academic scientist must be knowledgeable about codified and uncodified rules of the institutions, journals, and methods of obtaining funds and attracting students. This chapter discusses the formal elements involved in the practice of the profession, which have a bearing on the status of women academic scientists. But there is a caveat here. The discussion here does not show that rules or the formal working of the organisations by themselves are faulty, but that biases, stereotypes and prejudices are present even in the formal application of rules.

4.2 Lack of Critical Mass

The percentage of women to the total number of faculty in science and engineering in the selected institutes is quite small. Table 4.1 shows the number and percentage of women faculty in the four institutes, excluding the faculty in humanities and management departments and those in the training centres.

Table 4.1: Women Faculty as Percent of Total Faculty in Science and Engineering in the Four Institutes

Institute	Total	No. of women faculty	Percent of the total faculty strength
IIT Kharagpur	404	17	4.21
IIT Delhi	333	25	7.50
UOR	321	22	6.81
JU	516	45	8.70
Total	1574	109	6.92

The table shows that the percentage of women in each institute is quite low. Taking the four institutes together, the percentage of women faculty in science and engineering is only 7%. Thus, there is a of lack of critical mass, and, since women constitute a small minority in science and engineering departments, they can be studied as tokens.

As discussed in Chapter 3, about half of the respondents are lecturers or assistant professors. Only one fourth are professors: there are four women professors at IIT Kharagpur, eight at IIT Delhi, three in UOR and five at JU. It is striking that though the Mechanical Engineering department is a large department in all the institutes, there is not a single woman faculty in it at any institute. The strength of the department in IIT Kharagpur, IIT Delhi, UOR and JU is 40, 52, 40 and 75 respectively. Thus, for 207 men faculty in mechanical engineering there is not a single woman faculty. The following sections show that the reasons for a low proportion of women, especially in traditional engineering branches are not merely structural but organisational and institutional as well.

4.3 Appointments and Promotions

All four organisations are supposed to make appointments and promotions based on merit. There are formal rules to consider applications for research projects, and to allot funds for attending conferences and seminars. Assignment of research scholars or acquiring administrative positions involves rational procedures, free from any bias. However, behind the seemingly 'scientific' and rational decisions in these matters lie indeterminacy and elements of uncertainty, and the effects of informal relations and interactions.

The appointment or promotion of a faculty is made according to rules. But about 40% of the respondents reported 'subtle' or 'covert' discrimination in favour of men. Even amongst those who reported that there is no bias against women, some remarked that a woman's bio-data has to be 'really good' or 'women have to work harder to prove themselves'. Even in the interviews at the national institutes, women have often been asked questions, such as 'why do you want a job?' or 'how will you take care of your family?' In one institution, an interview committee member remarked:

> You are here for wrong reasons. Why come for the interview when you can look after the family?

Even if such remarks are made 'innocently', they affect the self-image of the women candidates and can be quite harmful. Another respondent from the same institute pointed out that when the institute has someone else in mind that they wish to promote, they raise marriage and family issues to eliminate a woman candidate.

The interview committees (for appointment of faculty), according to the respondents, reflected various social prejudices, such as fear of unmarried woman candidate getting married and losing commitment, of a married woman leaving the job

to join her husband, working elsewhere. More often than not, committees doubt a married woman's commitment and ability to devote time to their profession. Committee members are also influenced by stereotype notions such as women cannot do field work or that they will not be able to handle male students. There is also a perception that a woman is taking away a male candidate's seat or job. The assumption here is that while for a man, it is a matter of bread and butter to get a job, there is no such need for a woman.

In one institute, administration seemed to favour men until the new administrative head took over in the early 1990s. One respondent, aged 50 years, whose husband is also a faculty member, said that she was unfairly denied lectureship three times before she finally got the position. On one occasion when she applied for a faculty position, a committee member remarked, 'you will not be able to do justice to the institute'. A younger respondent in the same institute was forced to join the department of Management Science though she was qualified to be a faculty member in the Computer Science and Engineering department because her husband was a faculty there and the institute did not favour hiring a couple in the same department. In another institute, a respondent said, 'before the late 1980s, men were definitely preferred; since then things are gradually changing'.

In one institute, a respondent, now on the verge of retirement and distinguished in her field, was on an interview board that was selecting faculty. She saw male members argue that a male candidate was better than a female candidate. She noted that, 'young unmarried girls are usually not preferred'.

The influence of social prejudices is explicitly brought out in the responses to the following question: 'Do you agree that the system judges more by the stereotype or that this is not the case?' Table 4.2 shows the percentage distribution of responses.

Table 4.2: Distribution of Respondents According to Nature of Judgement

Response	Number	Percent
Stereotype judgement	28	36.8
Judgement by ability	23	30.3
Can't say	23	30.2
Both stereotype judgement and judgement by ability	2	2.7
Total	76	100

It clearly shows that only 30% of the women reported that the system judges a person truly by ability. About 37% of the respondents reported that the system judges by stereotypes. About 30% of the respondents could not give a clear answer which could be interpreted as a reflection of their thinking that judgement may sometimes be based on merit and sometimes on stereotypes.

In one institute, the earlier practice was to not to appoint women as faculty in civil and mechanical engineering departments. After 1990s only women have been permitted entry in these departments. In two institutes they are still not preferred in the mechanical engineering (ME). Biases such as mechanical engineering not being suited for girls are very common and show up at the time of selection for both undergraduate and postgraduate courses, and faculty positions. In one institute there was no female student (due to discrimination in selection of students in the ME department) till the 1980s.

Interestingly, while the traditional engineering branches like mechanical engineering are perceived to be a male domain, new fields like computer engineering and biotechnology do not suffer from this handicap. In our sample there were 12 women faculty members in electronics and computer science engineering departments. Women are actually encouraged by the government to take up courses in biotechnology. In a 'Colloquium on Biotechnology for Women: Vision for 21st Century' (September 17, 1998), held at the Department of Biotechnology, Ministry of Science and Technology, the following statement was made:

> It has been recognised by the Experts Committee and a large number of distinguished women biotechnologists and biologists in the country that women in general have keen interest in pursuing biology as a profession. It is also fully recognised that the present age of "modern biology" has to offer in a significant way for developments in the next century...It is, therefore, necessary that more and more women scientists and technologists are enthused and encouraged to take up bioscience as a career.
> (See Appendix C.)

Thus, there are certain preconceived notions about the preferences of women and suitability of a branch for them. Certain areas like mining are barred to women candidates. Women candidates who qualify for the prestigious Joint Entrance Exam of IITs are not given mining because Section 46(1), Mines Act of 1952 of Government of India does not permit them to do their practical training. Moreover, at the time of counselling in many institutes women candidates are advised not to opt for courses like mechanical engineering and metallurgy.

4.4 Allocation of Research Students

A major part of research in the four institutes is carried out through research scholars. These scholars are M.Tech and Ph.D. students who have to work on their thesis after completing the required course work. They receive fellowships after clearing GATE

examination or examinations conducted by the University Grants Commission / Council of Scientific and Industrial Research. They are also supported by the projects of faculty members. The students give their choice of adviser. The higher is the number of research students with a faculty member, greater is the latter's capacity to carry out research, and produce papers, and reports.

The institutes do not have any formal written rule, which defines the method of assignment of research scholars. The practice varies from institute to institute, and, within an institute from department to department. The respondents were asked: 'Do you have any problem in assignment of research scholars?' About 35% of the respondents said 'yes' and 65% said 'no'. However, the institute-wise break-up of the response gives some illuminating insights (Table 4.3).

As Table 4.3 shows, more than half of the respondents in Institute C, and 35% in the combined sample, said that they had problems in allotment of research scholars because they are women. In Institutes A, B, and D students give their choices and the department then distributes them 'equitably'. In Institute C, the department went by the student's choice alone. Students usually prefer guides who are senior, well known and can be seen to have more contacts. Women faculty members at senior level are quite few. They are seen to have fewer contacts and less time available for academics as compared to men faculty. The departments in this institute do not distribute scholars among faculty 'equitably'. Thus, a senior faculty member could have 8-9 scholars while a younger member could have none. A young woman faculty is at the lowest level of the faculty hierarchy in such institutes and, therefore, is least likely to have a research

scholar. This shows how seemingly egalitarian norms can lead to disadvantages under the impact of indeterminacy.

Table 4.3: Institute-Wise Percentage of the Respondents Reporting Problem in Assignment of Research Scholars

Institutes	Percent		Total
	Yes	No	
A	27.7	72.3	100
B	33.3	66.7	100
C	55.0	45.0	100
D	28.6	71.4	100
Total	35.2	64.8	100

Women faculty suffer from the biases among the students as well. According to one respondent from Earth Sciences department in Institute C:

> Research scholars prefer to join male faculty because scholars are usually male.

The biases of the men faculty along with those of the male students complicate the situation. As one respondent from the Chemistry department at Institute B remarked:

> Research students are hesitant to join junior women faculty and the department also discourages them from joining women faculty.

Another respondent from Mathematics department in Institute C said that:

> In the last four or five years there have been few research scholars, so mostly senior faculty members have them.

In the absence of any clear and stable policy at Institute C, politics in the departments is rampant, which affects women adversely. One respondent from the chemistry department (which had only two women faculty out of nineteen) said:

> Male members mould policies to suit their interests or to favour some faculty of their choice. I took a non-fellowship student (that is, a student not receiving CSIR fellowship) and was told that for the next three years, I could not take any student. But in the next semester, another faculty member in the same situation was favoured with a student through change of rules.

In the other institutes, respondents in some departments faced 'rivalry among the peers', seniors influencing the decisions in meetings on assignment of research scholars, and the head of the department indulging in favouritism. A woman faculty at Institute A (the only one in her department) was staying alone while her family was in another city. The department did not give her any research scholar due to their *belief* that she will soon leave to join her family.

The crux of the problem is that research scholars are a scarce resource for the faculty. As a few respondents pointed out, not many students are coming for research, so those faculty who are powerful take most scholars. Women faculty members constitute a minuscule proportion in most departments. This may not affect senior or accomplished women faculty members, but those at junior level are liable to be marginalised. This is true for a few departments in all the institutes. The stereotypes influence both faculty and students. As one faculty in Institute D remarked, 'many students think that women faculty don't know much'.

4.5 Funding of Research Projects

There are two types of research: theoretical and applied. Most of the time researchers in India are engaged in applied research, which requires financial support outside the institute. Funded projects are obtained from DST (Department of Science and Technology) and other government funded agencies. Certain tacit elements are involved in obtaining projects as well, which has an adverse effect on women. A senior woman

faculty at Institute B remarked, 'contacts are required to obtain funds from government and other agencies and it is not easy for women to have contacts'. Another respondent from the same institute said, 'amount for women get slashed more' and one from Institute D said, ' sometimes the agencies want to verify if the lady can do field work'. While some agencies and government departments might create problems, this is not true of all of them. All India Council of Technical Education and University Grants Commission encourage women faculty by providing them with money.

An application for a project is made to the funding agency through the institute (proper channel). The forwarding notes of the head of the department and the Dean are required on the application. While in some institutes this may only be a formality, in others (especially in the universities), there is usually a great deal of administrative interference. Politics and bureaucratic hurdles affect the submission of projects to the sponsors. Women faculty face problems in such an environment due to lack of 'influence'. According to one respondent in Institute C, 'senior professors do not forward our applications on the grounds that teaching will suffer if we take up a research project, and seniors will have to take a heavier teaching load'.

Obtaining funds for seminars and conferences also involves bureaucratic hurdles and involvement of the staff. In Institute C, a respondent remarked that she did not apply for funds at all because it required a great deal of running around and decisions suffer from favouritism. Another respondent overheard a staff member saying '*lagaane do isko chakkar'* (that is, *'let her keep running around').* In Institute A, a senior respondent in Electronics Department was denied funds for going abroad while a male faculty in the

same situation got the funds. The respondent even complained to the Prime Minister about it but nothing came out of it.

4.6 Resource Availability

No institute makes a distinction between men and women as far as the allotment of various resources is concerned. However, in practice, resources seem to be less available for women. Table 4.4 presents data on the perceptions of availability of the various resources for men and women on the scale of 1 to 3. Non-availability is ranked as one and easy availability as three. A higher value of mean denotes a greater availability of a resource.

Table 4.4: Average Availability of the Infrastructure Facilities to Men and Women in the Institutes

Item	Men		Women		p
	Mean	S.D.	Mean	S.D.	
Laboratory equipment	2.72	.45	2.65	.51	.21
Materials	2.62	.48	2.56	.53	.27
Institutional funds	2.58	.49	2.47	.58	.11
Classrooms for extra class	2.76	.49	2.74	.54	.40
Teaching aids	2.71	.51	2.65	.56	.23
Computer and the state-of-art technology	2.74	.47	2.63	.54	.10

As seen from the table, all the p-values (for t-test) are higher than .05. Thus, the difference in the averages for men and women are not statistically significant (one-tailed test). However, the mean in all the categories is higher for men than for women. This suggest that there is some sense of relative deprivation with respect to the availability of resources. The biggest differences are in computer facilities and state-of-the-art technology, and institutional funds. However, these findings must be interpreted with

care. Perhaps a five-point scale rather than the used three-point scale could have given a better picture of perceived differences in resource availability.

4.7 Participation in Administrative Activities

Women are almost invisible at the higher echelons of administration. This is partly due to the fact that their ratio in the total faculty and particularly among professors is low. However, there are other reasons too, which are discussed below. Table 4.5 gives the number of women faculty (in science and engineering) in the institute level committees and as the Heads of Departments (HODs).

Table 4.5: Number of Respondents Involved in Institute Administration

Institute	No. of HODs	No. in institute committees
A	1	1
B	4	1
C	1	7
D	2	2
Total	8	11

Table 4.5 shows that there are only 8 HODs and 11 women faculty in committees higher than the departmental level. Usually HODs are professors and appointed by rotation. Thus, there is no discrimination against women faculty as such in appointment of HODs. But membership at the institute level committees could go to non-professors also. Thus, out of 77 respondents 26.4% (20) are in departmental or university level

committees. Women faculty usually avoid institute level involvement because it requires 'politicking', 'interaction with staff who do not like to take orders from women', and because of family constraints, lack of time and engagements during odd hours involved. But at least 65% respondents agreed that there should be more participation of women in administration since it will make the atmosphere more balanced and more sensitive to the needs of women. According to a respondent in Institute C,

> Women should be given a chance; they can do equally well and would like to bring changes.

There are no women Deans in any institute. Two women were offered a Deanship but they refused. These women felt that their research would suffer by taking up Deanship. But there are also two cases of senior women faculty in institutes B and C who were eligible and willing to accept the position but were not offered the post due to which they felt quite disappointed. According to one of such women, 'I was fit for the post of Dean but I was told that women can't work at night'. Another respondent said, 'these are political appointments and require *chamchagiri* (ingratiation)'.

There are several reasons why there are no women Deans. Three most important reasons given by the respondents are as follows. First, there are very few women faculty at the senior level. Second, the administrative work involves interaction with men staff and faculty. 'Men do not like to be bossed around by a woman'. Third, there are biases against women and the dynamics of power work against them. As one respondent in the pilot study said, 'the institute will not prefer women Deans'. The other reasons include (in the descending order of importance) a lack of ambition on the part of women, family constraints, and lack of time. About 17 respondents said that they enjoy administration or look forward to such a post. According to them, participation in administration would

help in building up seniority, respect and would give them a chance to frame policies that are needed to encourage academics.

Though administrative opportunity is not denied to women in principle, as is clear from the above, the fact remains that there are no women at top position. It may be noted that women's participation in administration is needed not from an equity perspective alone. Women's participation is important for their 'empowerment'. Administrative posts help to build up contacts, influence, and give an opportunity to prove oneself. Women's participation is also essential to make the administration more gender sensitive. Women's presence is required so that women's special needs could be recognised and their interests could be pursued.

4.8 Gender Insensitivity of the System

Academic science is practised in institutes that are heavily dominated by men. Administrative decisions and the overall work environment of the institutes reflect the views and needs of this majority. Thus there are a few rules that ignore women's point of view. Supportive facilities in the institutes indicate a neglect of women. This section looks at women's problems through an examination of rules and a neglect of women's needs.

4.8.1 Written rules

There are several written rules that inadvertently exclude women faculty. The medical rule is one example. This rule pertains to the medical benefits at a Central Government organisation. In this study, it affects the IITs. If a husband and wife are employed in the same institute, the parents of one of the two only will get the medical

facilities. Hence, if a woman faculty member in such an institute marries a faculty member in the same institute, one of the parents will have to forego the benefits. Considering the patrifocal structure of our society, parents of a wife are not a part of the Hindu joint family. Hence, it is the wife's parents who will have to suffer.

This rule was brought to the notice of the researcher during an interview. The respondent is the only child of her parents. She fought for her rights and wrote several letters to the Prime Minister and the Ministry of Human Resource Development. But no concrete result came out of it. A copy of one such letter is given in the Appendix-D. The respondent's parents are now dead. She regrets that even though her parents gave her the highest education, she failed to be a 'son' to her parents. She could not provide them with medical facilities as a matter of right even though she is a faculty member in a highly reputed institute. As mentioned in Chapter one, it is due to the perception that benefits of girls' education would accrue to their husband's families that dissuades parents from imparting high education to their daughters. Such organisational rules tend to reinforce such perceptions.

Somewhat similar is the case with the house allotment rules in one state institute. If both husband and wife are faculty members, the husband gets the house. If wife want a separate house, she cannot get it. In the state in which the institute is located, a woman employee used to get only three months of maternity leave while in the institutions governed by Central Government they get four months leave. Women faculty members at the institute carried out a prolonged protest over the issue. The rule was amended only towards the end of the year 2000, granting four months leave.

The language used in the official parlance also needs to be noted. In the directories or official lists of faculty a woman faculty has 'Ms.' or 'Mrs.' in the name. In the rulebook of one institute, faculty are repeatedly referred to as 'he' except in cases where rules apply to women only. No wonder that while in personal communication men faculty is addressed as 'Professor' or 'Dr.' the women faculty are addressed as 'Madam' or 'Ma'am'. Thus, language usage reinforces 'masculine' image of a scientist.

4.8.2 Supportive facilities

A lack of sufficient separate toilets and their poor maintenance, a lack of security for women on the campus and an absence of childcare facilities also point at the failure of the system to recognise women's special needs.

A respondent from Institute B lamented, 'the system is quite impervious to the needs of women'. This is borne out by the fact that the facilities for separate toilets are quite poor in the older buildings of not only this institute but of all the institutes. Their insufficient number and poor maintenance is a common complaint. The facilities might be poor even in some new buildings. As one respondent from the Institute D said that there was no ladies toilet in her department in the new campus which was built in 1989-90. She had to fight for a toilet in various committees and finally got one in the department in 1995 after six years of fight. In the pilot study also, women faculty reported that there were no women's toilet in the Tutorial Building.

Women faculty from the Institute A face a problem of a lack of security. Moving inside the campus is not safe at night, as non-campus persons seem to be present at that time. According to one respondent, 'often I have to work till late and go back when it is

dark. Security is a problem at that time.' However, these issues have not yet been highlighted or given sufficient attention by the institutes.

Another crucial need of women faculty is the availability of childcare facilities. About 71% women considered such facilities as 'very important', 29% as important and not a single respondent considered them 'not important'. UOR and IIT Delhi have made some efforts to provide institutional childcare facilities. UOR has formed a committee to manage them and made some funds available for this purpose. One of the women faculty members is the manager of the childcare services. However, the attention paid to these services is not enough, as some respondents were not satisfied with their quality. The manager herself remarked that the quality depends on the 'ayah' (maid for the children). On the whole, they have been beneficial to some women faculty and is better than the IIT Delhi institution. Here, the Ministry of Social Welfare established a crèche. The institute has provided space and a paid 'ayah' (maid) handles the children in the crèche. The crèche does not have any phone or permanent roof. Some women faculty members do send their children in this crèche in the absence of any other alternative. These two institutes have at least made a beginning in providing childcare facilities that are completely absent in the other two institutes.

4.9 Role of Teaching versus Research in Career of Academic Scientist

In the profession of an academic scientist, teaching is another important component, apart from research. A number of studies reveal that women faculty members are more likely than men to list teaching as their principal activity (Chrisler, 1998). While comparisons with men scientists is outside the scope of this study, an attempt was made to find the time devoted by the respondents to teaching, research and other activities.

Analysis shows that 56% of the respondents devoted maximum time to teaching, 21% spent more time on research than teaching, 21% spent equal time on research and teaching and only about 2% spent more time in committee work than either teaching or research. However, not all those who devoted maximum time to teaching enjoyed teaching more. Out of 43 respondents who spent more time on teaching, 28 enjoyed teaching more, and the rest enjoyed both teaching and research. On the other hand, all the 16 devoting maximum time to research enjoyed research more than teaching. Table 4.6 and 4.7 show the distribution of respondents according to activity to which maximum time is devoted, and activity enjoyed most.

Table 4.6: Distribution of Respondents According to the Professional Activities to which Maximum Time is Devoted

Activity	Number	Percent
Teaching	43	55.8
Research	16	20.8
Equal to teaching and research	16	20.8
Committee work	2	2.6
Total	77	100

Table 4.7: Percentage of Respondents According to the Professional Activity they Enjoy Most

Activity	Number	Percent
Teaching	28	36.4
Research	16	20.8
Both teaching and research	33	42.8
Total	77	100

Table 4.7 shows that more women enjoy teaching than research. It is generally believed that women's emotional involvement in teaching is the result of 'innate nurturing ability' (Chrisler, 1998, p.110). However, Chrisler believes that this may be due to desire to bring about change and a sense of empowerment in others, since education has been a transformational experience for women themselves.

The importance of teaching as perceived by women faculty members comes out in the statements of the respondents. A respondent in Institute B said, 'through teaching we relate to the future and can bring change'. Another in Institute A said, 'as a teacher we can inspire the younger generation'. Teaching, in turn inspires the teacher also. As a respondent from Institute D said, 'it keeps up our momentum'. Another from Institute A said 'only research does no good; one should be in touch with the students'. At higher levels efforts towards teaching help in research, too. This is particularly true about teaching at the postgraduate level. As many as 52% of the respondents said that undergraduate teaching is helpful in one's scientific career and almost all (98.7%) said that postgraduate teaching has been of help in research. Those who attached more importance to undergraduate teaching believe that the undergraduate students are bright and interaction with them is challenging. The interaction helps to clarify basic concepts and to broaden the knowledge base. At the postgraduate level, students are not as bright because the undergraduate students of elite institutes either go abroad or get lucrative software jobs. Many postgraduate students are from other provincial towns where mathematical level and teaching standard are not very high. Yet, teaching postgraduate students is important for scientific career since they can be taught new developments, a

teacher can expand more on the basics, and the involvement of postgraduate students in small projects helps in setting up experiments and data collection.

The data show that as many as 42.8% women faculty enjoy both teaching and research but they have to devote more time to teaching. This is because there is a higher teaching load in some departments. In Institute C, the tradition is to give more teaching load to the non-professors: the lower the rank, the higher the teaching load.

Ironically, teaching is not given due weight in promotion in the elite institutes. Research publications in reputed journals are the most important criteria to rising in the hierarchy of the profession. Women in the initial phase of their research career are able to devote less time to research due to family commitments and time devoted to teaching is a waste of time. At times, even when the research momentum is good, their performance tends to be underestimated. This is illustrated in the next chapter.

4.10 The Relation of a Woman Faculty with Women Students

Woman faculty members do not attach any importance to the sex of the students in academic matters. However, due to their greater awareness of the situation of a woman scholar, they usually empathise with women scholars and encourage them to do well in life. The respondents were asked if they had a preference for research scholar of a particular sex. About 70% of the respondents said 'no'. It did not matter to them whether a research scholar is a man or woman. A small percentage (14%) preferred women research scholars, and 12% preferred men research scholars. The rest (4%) did not respond. The high percentage of respondents saying 'no' to this question is understandable. The number of post-graduate students is so small and specialisation so advanced that the sex of the student normally carries no importance in accepting students. However, in their

interaction with women students, about 56% (43) of the respondents said that they encourage women students to go for higher education in science and engineering. They do so by giving such students advice on opportunities available for making a career; by actually providing opportunities to them; by making special attempts if a woman student is not able to understand a concept; by telling them what problems to anticipate in this career and by generally talking to them. Thus, majority of the women faculty members act as role models and mentors for the next generation of women in science. Some women faculty reported that women students, whether undergraduate or postgraduate, come to them for advice on some personal matters or for seeking solution to some of their problems. These respondents strongly recommend counselling for women students.

At the same time, about 40% make no special efforts to encourage women students. They treat them as similar to the men students. This indicates some amount of role conflict - should a woman faculty treat women student in the same way as men students (equalitarian norm) or should they make special efforts to encourage women students (positive discrimination)? Women faculty members, who preferred women research scholars said that they could relate to a woman better, women are more sincere and women scholars often prefer women advisor. Those women faculty members who preferred men scholars gave reasons that typically indicate the limitations for the women in science. According to them, there are too many problems attached to a woman candidate since she may get married in between the research program, girls have problems in the field work and due to security reasons it is difficult to make them work at odd hours. Having reached a successful stage, some women in science do not empathise with other women. Their style mirrors the traditional male stereotype. Such women

faculty members have been called as 'instrumentals' by Etzkowitz, et al. (2000) or 'Queen Bees' (Benokraitis, 1995).

4.11 Conclusion

To conclude, women faculty members face certain gender-related problems in the practice of a profession that is regarded highly for its universalism. The social norms prevalent in society are reflected in the formal structure of the institutes in a subtle manner. These social norms affect appointments, promotions, facilities, and the ability to bring projects. Women faculty members constitute a small minority at the present. Representation of women at senior level is very low. More than one-third of the respondents reported that in the allocation of research scholars, biases operate against women faculty. The respondents have a sense of relative deprivation with regard to institute facilities also. They are poorly represented in administration. Women spend more time on teaching although they enjoy both teaching and research. But, teaching does not bring any tangible rewards. In their overall performance as an academic scientist, the achievements of women academic scientists seem to be underestimated. This study shows that to be a successful academic scientist, merit is not sufficient. Informal interaction with other scientists outside the institution and contacts with colleagues and others are also essential. The following chapter deals with the role of informal interactions in the career of an academic scientist and the level of participation of a woman faculty member.

CHAPTER 5

THE INFORMAL ENVIRONMENT

5.1 Introduction

The last chapter examined the tacit and indeterminate aspects of the formal environment of woman academic scientists. This chapter focuses on the informal environment of the profession. It shows that the lack of a critical mass of women academic scientists results in 'tokenism'. Networks provide access to information to their members. Interactions and relations with colleagues, engagement in administration, and participation in the informal activities of the organisation make the scientists more effective in all the roles. This chapter shows that women academic scientists have limited informal communication with other scientists. This affects their ability to pool resources, information and expertise.

Etzkowitz (2000) is one of the first sociologist to stress the benefits of a strong network of contacts. According to Etzkowitz, such contacts lead to an accumulation of 'social capital'. Social capital refers to an access to resources through contacts. These resources include interpersonal trust and norms of reciprocity as well as knowledge of new scientific ideas and strategies for developing a line of research. Women scientists have been found to be deficient in social and professional ties and lack the high level of reciprocity that is observed in men-to-men relationships. Looked at from this perspective, this chapter examines the nature of informal interactions between respondents and others within and outside the institutes and its impact on the respondents.

5.2 Tokenism

As mentioned earlier, Kanter (1977) described problems of those who are a minority in a majority group, terming the situation as 'tokenism'. Tokenism involves three types of reactions, which occur simultaneously. One is that tokens (in this study, women) are more noticed for any blunders, atypical behaviours, etc. Their clothing, speech, and behaviour become the subject of review. Secondly, the presence of only a few tokens make the dominant group more aware of these tokens. Kanter found that this awareness ('boundary heightening') often led to the exclusion of women from some of the informal socialisation available to their male colleagues. Third, she found that women are often cast into stereotyped roles, such as, mother, a pet, the seductress or the iron maiden. Such roles underplay the effectiveness of an individual's personality and imply a condescending approach of men towards women.

As shown earlier, the women faculty members in this study form less than 9% of the total faculty in science and engineering in every institute and as low as 4% in IIT Kharagpur. This shows a lack of critical mass. Since women are a minority in these institutes, they can be labelled as 'tokens'. My study of the informal environment in the four institutes reveals the existence of all three aspects of tokenism.

First, respondents face the problem of heightened visibility; that is, the problem of being noticed more. This is brought out in the response to the following question asked in the interview: 'Do you think that since women scientists are very few, they are more noticeable and more carefully watched?' As many as 75.3% (58) respondents agreed that women are more noticeable. Out of these, a majority (65.5%) felt uncomfortable about it at least in the initial stages of their professional life. The term 'noticeable' was described in different ways. The most often used statements included the following: 'women's

achievements are downplayed while their mistakes are highlighted more', 'if I do something wrong it is considered a stigma for women', 'I feel that I am being tested all the time', 'everyone seems to know things about me'. Such situations can lead to two reactions among women: (a) lowering of self-esteem and acceptance of the view that they cannot do as well as men; (b) they understand the nature of tokenism and work hard to prove themselves. The manner in which individual faculty members might react depends on the organisational setting, family, and level of awareness. However, both of the reactions are abnormal and have their price.

The comments about woman faculty's clothing are not unusual. As one respondent in Institute A said, 'we never comment about the dress of a male faculty, why should they (male colleagues)?' The women faculty are quite concerned that they should not look the 'odd man out' because of being a woman. As one respondent said, 'we have to behave in a proper manner so that we don't stand out; we have to blend with others'.

Another reaction of tokenism is exclusion from informal socialisation. About 34% of the respondents felt that men colleagues often tend to form their own groups isolating women scientists and about 23.7% felt this did happen sometimes. The male faculty members have their own networks from which women are excluded. Men interact more freely amongst themselves and women find it difficult to interact with men colleagues. According to a respondent in Institute B, 'it is easier for men to grab opportunities because of their old boys' club, same tea clubs in which they discuss official matters'. Another respondent said, 'women are less incorporated in the old boys' network'. According to some respondents in Institute C, the language used in tea clubs is often embarrassing for women and such a language may become more offensive if a woman is not wanted in that informal group.

Informal interaction with colleagues within the institute is a problem in several ways. Due to social stereotypes about male and female mixing and women's heightened visibility, women themselves maintain a low level of interaction. As one respondent in Institute B put it, 'if women talk to gents for a long time, people tend to misunderstand and link your name with that man'. Another in Institute A said, 'we have to come close in work but the society takes it otherwise'. Due to this reason, women are quite wary of going in the rooms of male faculty members only to chat. They go mostly for work reasons otherwise it may lead to 'floating of rumours'. In this situation, fear of gossip often prevents women academicians from socialising informally.

It is even more difficult for single women to interact with men and some of their experiences have been quite bitter. One such woman faculty in her late 30s in Institute C found it difficult to work due to a lack of a good work environment. On the first day of taking classes, instead of encouragement, she received this comment from a senior colleague, 'guys are going to throw you out; it's very difficult to deal with them'. According to her, men faculty members are 'not respectful'. They patronise. Another respondent from Institute A said, 'there is a troubling feeling that people are seeking more than friendship'.

Many women scientists were the lone women in their department. According to 43% of the respondents, there was no woman scientist in the department when they first joined. In such cases, gender and a young age were disadvantages. According to one such respondent in Institute A:

> When I joined, menfolk were a bit nervous whether I will be able to take classes. I was isolated. Colleagues did not invite me for tea. I was treated as a lady and not as a colleague.

Another respondent in Institute D, who is still the only woman in her department, (Department of Geological Sciences), said:

> There is a sense of isolation since I am not able to interact much professionally or personally. Initially I felt a bit of an outsider. I still get this feeling at times. But over the years I have stopped thinking about it.

Another aspect of tokenism is that the tokens are cast into stereotyped roles. To examine whether stereotypes are prevalent, I asked: 'do you think there is an expectation of stereotyped roles from women?' Half (51%) of the respondents said 'yes'. According to these respondents, stereotype roles include being looked upon as a sister or a daughter of male colleagues. This, in turn, implies condescending behaviour and not being treated as an equal. The stereotypes extend to formal situations too. A respondent in Institute B said that that women faculty are often expected to serve tea or take care of anything related to cooking and serving guest(s) of the institute. Offering flowers to a guest might be another task assigned to them.

In general, tokenism brings about isolation and has a negative effect on the overall work environment. By its very definition, 'tokenism' decreases if the numbers of those in minority are raised. In response to a question, respondents commented on the advantages of increasing the number of women scientists. About 64.5% respondents felt that such an increase would help in making the job environment more comfortable. Part of the reason is stated by a respondent from Institute B who said that presence of more women faculty would enable women to discuss and mutually solve their problems. This would make the environment more balanced. Another respondent from Institute C said that the presence of more women would put a restraint on men's loose talking and the male colleagues will become more respectful. Some respondents felt that an increase in the numbers of women would give women more say in the department and men colleagues would give more respect to the women's point of view. About 50% respondents agreed or partly agreed

that they had problems at times in the departmental meetings because they are women. Women often have to speak louder and harder than others since their point of view is either ignored or not given due importance. According to a respondent from Institute D, 'women being in minority are forced to compromise in the meetings'. With an increase in their number, women would be able to make their presence felt.

However, the respondents are against having a quota or reservations for women faculty in appointments and promotions to raise the numbers. As many as 91% of the respondents are against special quotas. To them quotas could lead to a widening of barriers between men and women faculty. They would like more women to enter this profession through merit only.

5.3 Microinequities

Many women experience that in various small ways they are treated as though they are different or inferior. This has been referred to as 'microinequities' and one of the most common microinequities in this profession is 'professional diminution', that is, questioning a woman faculty member's professional authority (Collins et al., 1998, p.8).

In the interview, the respondents were asked: 'do you face any problem in an overwhelmingly male environment? About 50% (39) replied 'yes'. The most common problem, as reported by 76% of those who replied in affirmative, was that there was a feeling that colleagues are not able to accept women as equals. The respondents get this feeling from actual attempts by men faculty to downgrade even the best of the work of the women faculty. The latter also develop such feelings from the unfavourable reactions of men colleagues when they try to assert or make decisions. As one respondent in Institute B said, 'men colleagues are unable to accept that a woman can take major decisions without their help'. In the pilot study, a woman faculty remarked, 'men colleagues take a

long time to see that a woman is equally competent'. Another from Institute A said, 'men are unable to accept that a woman of the same designation can do better than them'.

Positive reactions in extreme form also leave the impression that a woman is not at par. The men faculty members are sometimes too appreciative of small achievements of women faculty. As a respondent in Institute A said, 'even if I do something of little merit, men faculty show a lot of appreciation; such a reaction will not be shown to a man; they have a condescending approach to us'. One respondent said, 'the men colleagues treat women as women and when they are extra polite towards us it is quite irritating'.

That the performance of a woman faculty is underestimated is better brought out by the response to the following question: 'If there is a good woman scientist, will her efforts be overestimated or underestimated?' Table 5.1 presents the frequency distribution of responses.

Table 5.1: Distribution of Respondents According to Perceived Response to Efforts of Good Women Scientists

Response	Number	Percent
Underestimated	28	36.3
Overestimated	4	5.2
Correctly evaluated	26	33.8
Cannot say	19	24.7
Total	77	100

Thus, only 33.8% of the respondents felt that the male colleagues correctly evaluated their work. While 36.3% of the respondents felt it was underestimated, 5.2% felt it was overestimated. One-fourth of the respondents did not respond. The fact that

only one-third of the respondents could say that their work was correctly evaluated shows an existence of microinequities whereby women are seen differently.

During the interview some respondents remarked that questioning the professional competence of women is more likely in the initial stages of their career. Once a woman has established herself as an authority, there is less scepticism and greater respect for her professional qualities. However, it takes a long time to be accepted at par with men. Till then a great deal of effort is required to establish herself in profession. It is quite hurtful to be treated in a different manner. According to one respondent:

> The colleagues initially questioned my professional competence and tried to put me down in general talks. I had to be on my guard. Lot of professional energy was dissipated in that, otherwise I could have done much better.

Women receive less co-operation from their male colleagues than do men. In the perception of 70% of the respondents men easily receive co-operation from their colleagues while only 50% of the respondents perceive that women easily receive co-operation from male colleagues.

5.4 The Role of Informal Communication in Careers

Informal communication plays an important role in the careers of academic scientists because it provides visibility, access to information and recognition of one's work. Such qualities as hard work, intellect and creativity receive little recognition if a scientist works in isolation. Thus, success is not based solely on one's talent or merit. The respondents were asked 'do you agree that success in scientific research is not always in proportion to merit?' About 72.5% strongly agreed or agreed with the statement, 14.5% partly agreed, 13% disagreed and none disagreed strongly. This suggests that factors other than merit are important in careers.

Contacts outside and within one's organisation, informal networking with scientists, and geographic mobility are very essential for success in this profession. Table 5.2 shows the distribution of responses according to the perception of the importance of contacts outside the institute. Almost all the of respondents agreed that contacts, informal networking with other scientists, and geographic mobility are important in the career of a scientist. Mobility is required for attending seminars and conferences, for obtaining projects, and for maintaining informal communication. During informal communication scientific knowledge and professional information are often exchanged and groups formed to pursue common interests. If one is not mobile, it affects his/her chances of acquiring professional information. According to Reskin (Atkinson and Delamont, 1990, p.102): 'This information is sometimes available through formal channels...(but) some professional gossip may never become available outside informal networks...careers can suffer if a scientist does not hear gossip about who is helpful and who is not to be trusted.'

Table 5.2: Distribution of Respondents According to Perception of Importance of Contacts Outside the Organisation

Item	Very important	Important	Not-important	Total
Contacts outside the organisation	43.8	54.8	1.4	100
Informal network with scientists	41.9	55.4	2.7	100
Geographic mobility	36.0	62.7	1.3	100

According to the respondents in this study, contacts help in several ways. Almost 60% of the respondents believed that they provided information about new research, data, projects, collaborations and placements for students. Next in importance is the role of contacts in 'building a reputation', establishing oneself, and acquiring important positions. They are also important in getting grants and publishing papers. Respondents felt that

women academic scientists are not very active in maintaining informal network with other scientists, which hampers their career.

The respondents were asked questions about the level of contacts outside the institute, the mobility of the women faculty members, and their perceptions about the same for men. As Table 5.3 shows, women faculty members perceive their contacts outside the institute and mobility to be much lower compared to those of men faculty.

Table 5.3: Percentage Distribution of Respondents According to the Perceived Availability of Contacts for Men and Women Outside the Institute

Item	For Men				For Women			
	1	2	3	Total	1	2	3	Total
Contacts with successful professionals in the same area outside the institute	69.9	28.8	1.3	100	34.7	55.6	9.7	100
Contacts with persons of superior/equal ranks outside the institute	64.9	32.4	2.7	100	30.1	58.9	11	100
Contacts with persons of subordinate ranks in different fields outside the institute	63.9	30.5	5.6	100	29.6	52.1	18.3	100
Ability to move from one place to another	79.7	17.6	2.7	100	60.3	16.4	16.4	100

*1 = easily available, 2 = not so easily available, 3 = not available.

Table 5.3 shows that contacts with successful professionals in the same field outside the institute are perceived to be easily available for men by 69.9% of the respondents, and for women by only 34.7% of the respondents. As many as 64.8% respondents felt that contacts with persons of superior or equal ranks outside the institute are easily available for men, while only 30.1% felt that such contacts were easily available for women faculty. Contacts with subordinates were also perceived to be lower for women faculty than for men faculty. Geographical mobility shows the greatest disparity in figures: it is easy for men to travel according to 79.7% respondents and easy for women to do so according to only 23.3% respondents.

Women scientists not only lack contacts outside the institute but also within the institute. The latter is important in acquiring important administrative positions and in understanding internal politics. According to one respondent in Institute B, 'climbing is not by talent; contacts are important for acquiring an important position'. Another in institute C said, 'after one attains the highest academic rank of professorship, all appointments to important administrative positions are political; they are based on networking and preferences'. More than 75% of the respondents felt that contacts within the institute are easily available to men. A much lesser percentage (45%) of the respondents thought that contacts are also easily available to women (Table 5.4). For more than 50% of the respondents, contacts are not easily available to women scientists within the institute. Still it seems that in case of women scientists, contacts within the institute are more than those from the outside.

Table 5.4: Distribution of Respondents According to the Perceived Availability of Contacts for Men and Women Within the Institute

Item	For Men				For Women			
	1	2	3	Total	1	2	3	Total
Contacts with persons of superior/equal ranks within the institute	79.4	19.2	1.4	100	43.0	52.8	4.2	100
Contacts with persons of subordinate ranks in different fields within the institute	77.1	22.9	0.0	100	45.0	47.8	7.2	100

Women scientists lack usually contacts within and outside the institute because of various reasons. The most important reasons cited by about 84% respondents are related to gender. According to them women lack contacts because of various reasons, such as:

- interaction with men scientists (20 responses)

- family constraints (14 responses)
- a lack of mobility (12 responses)
- a lack of time (9 responses)
- any other (4 responses)

As discussed earlier, interaction with men scientists is problematic. Women are often excluded from informal socialisation. Due to prevalent stereotypes, Indian women themselves do not socialise much with men compared to the Western women. According to a respondent in Institute A, 'women are more inhibited in interaction and when they have to interact with males it is a social problem'. Another respondent from the same institute said, 'if a woman interacts freely with men, she is labelled as characterless'. According to a respondent in Institute B, 'women lack accessibility of contacts; they cannot chat or drink, and sit in the evenings, in which names for various committees are decided'. Family constraints and lack of time due to family pressures are also responsible for fewer contacts. The category of 'any other' includes various other responses such as an absence or a small number of women scientists, the 'idealistic nature' of women (who ignore practical aspects, such as, the need for contacts in career), some general issues including poor e-mail facilities, and personality factors (such as, reserved by nature). About 16% of the respondents said that nowadays women scientists do have more contacts primarily because of e-mail facilities. E-mail enables a person to maintain contacts with the outside world without requiring face to face interaction. Lack of mobility is one of the reasons for the lack of contacts. Number of (71%) respondents felt that women scientists usually travel less than men scientists do. Various reasons were cited by the respondents for the lack of geographic mobility. About 64% of the respondents believed that this was mainly due to family commitments. A younger faculty member said that she would be attending seminars and conferences more when she became older. Lack of

security and, problems in travelling alone at night were some other reasons cited by them.

Networking with other scientists is important for recognition. One way of joining networks is to attend conferences and seminars. These seminars and conferences bring scientists from different areas together and help in providing links with others. Women scientists with a family find it difficult to attend such conferences and seminars because they require travelling. Women scientists also have more family constraints. The respondents were asked questions about the usefulness of conferences and seminars in their academic career. Table 5.5 shows the responses. About 90% of the respondents agreed that conferences and seminars help in increasing contacts and networks, 83% respondents felt that they are useful in bringing new ideas for research and about 75% said that they bring the work of less well-known scientists in limelight. Conferences and seminars usually accept papers or working papers from all those interested to participate in them. This provides opportunity to all scholars to present their conceptual and experimental work. In this way the researchers get feedback on their work and an occasion to show their work to others. Often this is followed by building of terms in new areas.

Table 5.5: Percentage Distribution of Respondents According to the Perceived Importance of Seminars and Conferences

Statement	Strongly agree	Agree	Partly agree	Disagree	Strongly disagree	Total
They help in increasing contacts and networks	51.3	39.5	6.6	1.3	1.3	100
They are useful in bringing new ideas for research	40.8	42.1	15.8	1.3	0	100
They bring the work of less well known scientists in limelight	26.3	47.4	21	5.3	0	100

The participation of women scientists in the seminars and conferences is probably hampered by family constraints. This is brought out in the age-wise distribution of the

average participation rate of the respondents in the last three years. Figure 5.1 shows the age-wise average participation of respondents in seminars and conferences over the last three years.

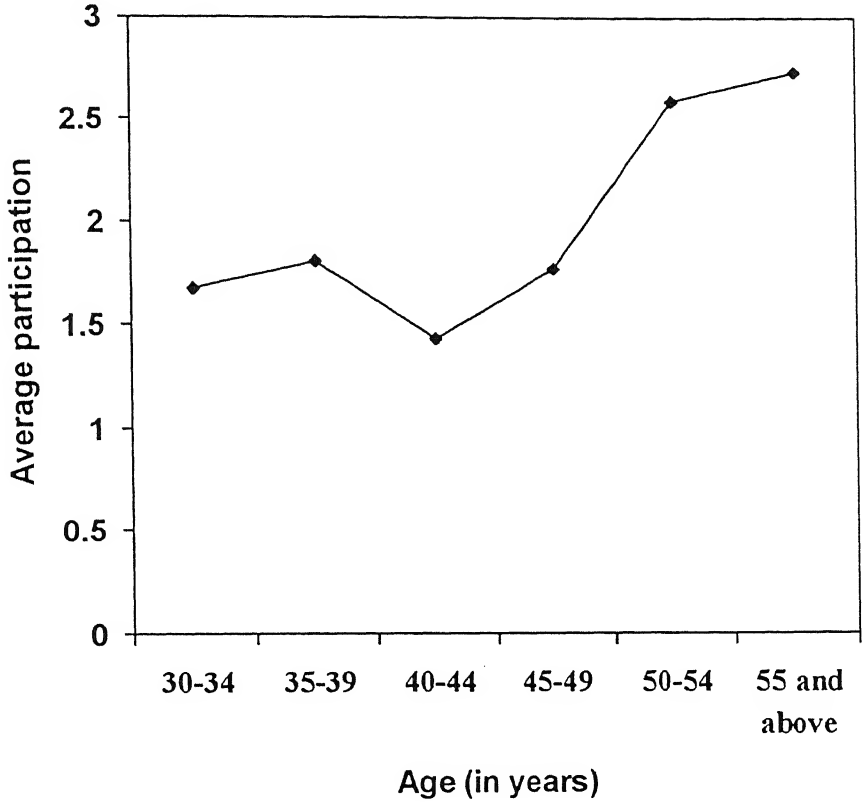

Figure 5.1: Age-Wise Average Annual Participation in Seminars and Conferences

Figure 5.1 shows that women in the higher age bracket have the higher average rate of participation in seminars and conferences. Those in the age group of 40-44 years have the lowest rate of participation in conferences and seminars. This participation increases between 45-49 years but it still remains at the same level as the participation of the age group 35-39 years. Participation of women increases consistently only in the 50s. This trend is further supported by Table 5.6, which shows the research productivity of respondents in various age groups.

Table 5.6: Average Annual Research Output by Age of Respondents

Age (in years)	Average number				
	Journal papers	Participation in Indian conferences	Participation in international conferences	Indian conference papers	International conference papers
30-35	.90	1.04	.62	.30	.45
35-40	1.54	1.61	.28	.57	.49
40-45	1.23	1.18	.26	1.00	.65
45-50	1.25	1.49	.28	1.08	.45
50-55	1.46	2.15	.44	1.6	.87
55+	4.6	1.96	.85	1.4	.88

Table 5.6 shows a high level of research activity among women in their 50s. There is a particular increase in the research activity of the respondents in the age group 50-55 years compared to the previous age group of 45-50 years. The table also indicates that in the age group 40-45 years there is a reduction in participation in Indian and international conferences, and in the number of journal papers. The decrease in the research activity in their early 40s is probably due to the fact that the children of women in this age group are likely to be in high school or in higher secondary, which are crucial years of schooling in India. The entire career of a child depends on the examination results of these classes. Hence, considerable attention has to be given to children. This curtails their mobility to a great extent. As one respondent said, 'I have put all the offers for seminars and conferences aside since my child is giving his high school examinations'. The low research activity in the younger age group is probably because the younger women scientists are likely to have young children, thereby restricting their mobility. Young women scientists are also less likely to have wide contacts and collaborations than women scientists of a higher age, which may account for a low research activity in the younger age group. In the 50s women scientists have more time to themselves and, more contacts and networks. This may explain their high level of research activity.

Women scientists are very few in numbers in the professional gatherings. Hence they are easily noticeable. This is a cause for reserved behaviour of many such women. This in turn hampers their development of contacts. According to one respondent in Institute B, 'Women in scientific gathering do not like to speak to everyone. But for men, it looks very natural'. A lack of contacts affects visibility in a professional group. This implies that the core group in the area of one's interest might not be fully aware of the work of the scientist who is less visible. Within the institute a lack of visibility decrease the chance of being in powerful positions. Thus, there is greater isolation and a greater dependence on personal abilities and hard work. Greater isolation in turn implies fewer contacts.

A lack of scientific contacts affects collaborations. As many as 28.6% (22 out of 77) respondents had no collaborations. Among those who had collaborations (55), 30.9% had collaborations within their institute only, 47.3% had them both within and outside the institute, and 21.8% respondents had collaborations only outside the institute. A majority of those who collaborated, 63.1% did so only with men. The reason given for this was the scarcity of women scientists in their field. Seventeen respondents collaborated with both men and women and only two collaborated with women only.

Thus women academic scientists are often trapped in a vicious circle. As discussed earlier, women faculty members socialise less with men who form a greater mass of the community of academic scientists. Fewer interactions mean fewer contacts. Fewer contacts imply less visibility and less visibility means fewer interactions. The vicious circle is presented in Figure 5.2.

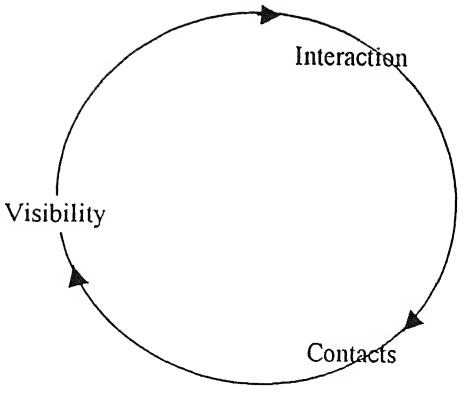

Figure 5.2: Vicious Circle of Informal Interaction

5.5 Interaction with Clerical Staff and Students

As faculty members involved in teaching, research and administration, women scientists have to interact with clerical staff and students, both formally and informally. Some women respondents feel that clerical staff, like many men, treats women faculty differently from the men faculty. This difference in behaviour is paradoxical, however. On the one hand, the respondents felt that the staff gave them more respect than to men faculty. On the other hand, there is a hesitation in accepting orders from women faculty. According to a respondent from Institute B, 'staff has a problem in taking orders from women. We have to convince them more. But this is also true that their behaviour towards women is more polite'. A respondent from Institute A said, 'staff doesn't like to be shown anger by a woman'. Compared to those respondents (68%) who felt that staff easily co-operated with men, 58% of the respondents felt that staff easily co-operated with women.

Women academic scientists interact more freely with women students than men students as indicated before. This is because such women scientists act as mentors and role models for women students. Also, as one respondent said, men students are sometimes

attracted to women faculty. So the latter have to maintain safe distance with them. Only about 13% of the respondents felt that students underestimate their performance as academic scientists. About 61% said that their performance is neither underestimated nor overestimated. 25% 'cannot say' anything on this issue. Only one respondent said that it is overestimated. The men students address women faculty as 'sir' sometimes since they are used to seeing the men faculty. A few respondents have received anonymous calls and mails traced to students. Though less than 10% of the respondents have faced such incidents of harassment, they have a demoralising effect on women faculty.

5.6 Informal Activities on the Campus

Every institute has some organised informal activities, which involve interactions among the faculty, staff and students (such as, sports, faculty club activities, religious and cultural events by linguistic groups, literary societies, the photography club, the astronomy club, etc). Such activities help to build up contacts, provide visibility and furnish information on the affairs - official and unofficial - of the institute. The respondents were asked, 'do you agree that participation in informal groups and activities may have some bearing on one's career?' A majority of the respondents (about 75%) agreed that such participation is significant. The respondents also agreed that such activities provide visibility and help in building up informal contacts. Table 5.7 shows clearly that participation in the informal activities helps in building informal contacts and provides information which may be useful for career advancement. Such activities may lead to the formation of groups. Members of such groups may help each other to further the interests of its members. About 49% agreed that informal activities might lead to formation of cliques. According to a respondent from Institute C 'through such activities one gets to know about others; one can get feedback about his/her performance and can learn from

mistakes'. According to some respondents, such activities provide 'information about internal politics'; they help in administrative matters and are important in climbing up the institute hierarchy. About 42% of the respondents felt that women lack contacts partly because they are unable to participate in them. This aspect is elaborated in the following section.

Table 5.7: Distribution of Respondents According to the Importance of Participation in Informal Activities

Item	Strongly agree	Agree	Partly agree	Disagree	Strongly disagree	Total
Participation in informal activities provide visibility	12.0	46.7	30.7	8.0	2.6	100
They help in building contacts	13.3	70.7	16	0.0	0.0	100
Informal contacts provide useful information	9.5	44.6	35.1	10.8	0.0	100
Such activities can lead to the formation of cliques	10.7	38.7	38.6	10.7	1.3	100
Women lack contacts partly because of inability to participate in them	10.7	32.0	36.0	18.7	2.6	100

Given the significance of such participation, I examined the extent of women faculty's participation in different activities. The respondents were asked about the level of participation of men and women faculty members in various informal activities on the campus on a five-point Likert scale. The mean and standard deviation of the degree of participation by men and women faculty is shown in Table 5.8. In the table a higher value of mean shows higher degree of participation. Since all p values for t-statistic for difference of means are less than .05 it may be inferred that the differences between the means are significant at 5% level of significance (one-tailed test).

Table 5.8: Participation by Men and Women Faculty in Different Informal Activities

Activities	Degree of participation				p
	Men faculty		Women faculty		
	Mean	S.D.	Mean	S.D.	
Sports	3.08	1.03	1.91	0.86	.00
Hostel activities	3.34	1.05	2.51	1.03	.00
Activities of cultural associations	3.28	0.84	2.87	0.93	.00
Movies shown on campus	3.01	1.09	2.55	1.10	.01
Faculty club activities	3.5	0.78	2.59	.94	.00
Social service programs in institute	3.17	0.96	2.69	1.03	.00
Tea lounge in institute	3.67	1.00	2.73	1.03	.00
Overall mean/S.D.	3.30	0.11	2.55	.08	

Table 5.8 clearly shows that, according to the women faculty, their participation in the informal activities is less than that of the male faculty. Differences between means for all the activities are statistically significant which shows that women faculty's participation in informal activities is significantly lower than that for men faculty.

Figure 5.3 shows the same differences in the form of a bar diagram. The diagram clearly depicts the differences in the level of participation in different activities on the campus for men and women faculty.

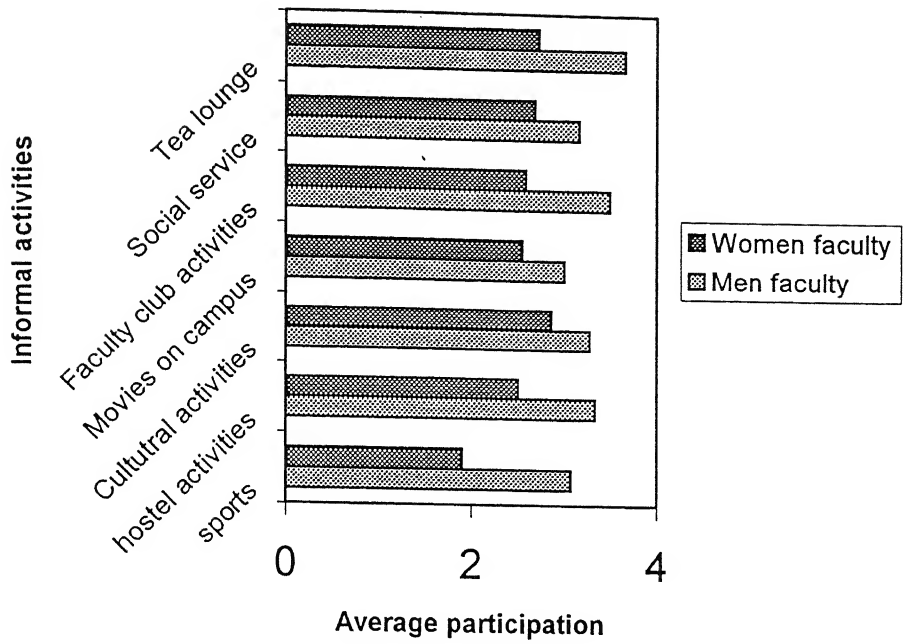

Figure 5.3: Average Participation of Men and Women Faculty in Informal Activities

Informal activities and interactions lead to interpersonal relations which often take the form of "pull", "prejudice" or "favouritism". Prejudices and favouritism are group phenomena and they occur in work organisations as an extension of friendships, clique life and personal antagonisms (Miller and Form, 1964, p.226). Thus, it is important to know if the respondents felt that these groups existed and if they formed a part of such groups. I asked the respondents, 'Are there any powerful cliques in your department?' About 77.9% of the respondents admitted that there were powerful groups in their department, 18.18% said 'no' and 3.90% said that they were not aware of any such groups. Out of those who admitted the presence of such groups, only 14.67% formed part of some group. As many as 85.42% of the respondents were not a part of any group. According to the respondents, women do not usually form part of groups. Only 17.56% respondents said that women do form part of cliques.

Groups usually exert influence and some groups are more powerful than others. They might influence decisions in the favour of their members. The respondents were

asked if such groups influence decisions in the department. As many as 71% respondents replied in affirmative, only 6.6% said that such groups do not influence decisions, 4.2% were undecided and said that they 'may influence' and the rest (18.2%) said that there are no informal groups which influence decisions.

It was observed that groupism in the departments was usually based on common interests, common area of specialisation, seniority, and vested interests or cliques as shown below. Due to multiple responses the number of responses is high.

- common interests of persons (22 responses)
- common field of specialisation (20 responses)
- seniority (12 responses)
- vested interests or cliques (6 responses)
- other factors (9 responses)

The category 'other factors' includes other bases of group formation. Thus groups were also reported in some departments on the basis of gender, caste, on basis of those who had their basic degree from an IIT vs. those who had degree from other places, and in some engineering departments, groups were reported on the basis of those from science background vs. those from engineering background.

5.7 Perceptions and Experiences of Women Faculty Reflecting Stereotypes

As seen above, prejudices prevalent in society are reflected in the work organisations as well. This has serious repercussions at times. One respondent from Institute A narrated her experiences in the institute:

> I am a Ph.D. in XYZ. I joined the Department of XYZ in 1992. The department is heavily male dominated. The HOD created some personal problems and harassed me. He behaved badly, such as writing personal letters to me. Other faculty members supported the HOD. Only the students supported me. I did not complain and remained quiet. But the mental harassment continued. There was a lot of professional jealousy as I was growing better than my colleagues of the same status. It was HOD who complained

> about me to the Director and said bad things about me. The Director called me and asked questions. I showed him the letters written by the HOD. So the Director transferred me to the Department of ABC. Here also I am the only woman faculty but the environment is better. I enjoy more in the laboratory than in informal activities and I hardly take interest in them.

In the above example, the consequences of the ill treatment had to be borne by the victim herself. No action was taken against the perpetrator. It seems to have led to a deliberate isolation on her part as she sticks to her work and keeps interaction to the minimum. Since she is unmarried, one might conclude that her marital status is the root cause of her problems. However, this is not an isolated case. A respondent from the Electrical Engineering Department in Institute D had the following problem about four years ago. According to her:

> Problem occurred when I was given the charge of the PQR Engineering section in our department. Some seniors thought that a woman could not run the section and raised the issue in the departmental meeting. Though the section has continued to be under my charge, the rules related to its running have been flouted. Till date, I have not been given peons and technical assistants. One technical assistant was given last month for five days only and then transferred to another place. The seniors are gender biased. They are also my teachers since I did my doctorate from here, so they dominate over me. They don't like if I argue. Once a senior made a comment that other juniors are also learning to argue from me.

From the above, it emerges that groupism based on seniority combined with gender stereotypes can lead to a lot of problems for a woman faculty member. Also, arguments from women are frowned upon. Other respondents also remarked this. For example, one from Institute B said,

> I am made to feel slight in the department even now because I am a woman though I joined in 1994. They don't like a woman with independent views, and pass comments.

Finally, the belief that women should look after the house and that a career should be secondary is brought out in several ways. According to one respondent, 'if I am late in coming to the department, it is attributed to domestic duties at home, while if a man is late, he is considered to be busy in some legitimate work'. According to another respondent, a man colleague was heard as saying 'she always comes at nine in the morning.

She does not seem to have any work at home' and she felt that it was more expected of her to go back home at five in the evening. The patrifocal attitude of men scientists was also brought out in response to the question about their perceptions of how men scientists feel about women scientists (Table 5.9).

Table 5.9: Distribution of Respondents According to their Opinion about Perceptions of Men Scientists

Item	Agree	Partly agree	Disagree	Total
Men scientists feel that women scientists are different from normal women	59.5	16.2	24.3	100
Men scientists feel that women scientists do not conduct research of good quality compared to men	34.2	14.5	51.3	100
Men scientists feel that women do not make good administrators as compared to men	45.5	16.8	37.7	100
Men scientists feel that women are too emotional compared to men	57.5	27.4	15.1	100

About 60% of the respondents felt that in the perception of men scientists, women scientists are different from normal women. 'Normal women' were defined as those who are seen to be more involved in family life than career. About 50% respondents agreed (fully or partly) that men scientists feel that their research is not of a good quality compared to men. A majority of them agrees that in the perception of men scientists, women do not make good administrators. Conforming to traditional stereotypes, women are considered more emotional, which implies a lack of rationality in behaviour. Thus, this study confirms the findings of other studies (Pattatucci, 1998) that women are considered too emotional to be good administrators and leaders.

Respondents reported several stereotypes during the interviews: 'women are less original', 'family is more important for women', and 'women are less committed to their profession'; seventeen respondents actually said that it is a male dominated profession and

men find it difficult to accept women as equally capable. Often women academics have to be on their guard so that they get the fair treatment due to them. According to a respondent from Institute B, 'if we are not vocal, we can be taken for granted'. Another said, 'we have to be cautious, otherwise we would be taken for a ride'.

Women's perceptions about how men scientists feel towards them have an effect on their self image. In reacting to the stereotypes women scientists probably have only two choices. Either they subordinate themselves to the stereotype judgements about themselves and accept the patrifocal environment in which they work or they rebel against such stereotypes. In the latter case they run the risk of being labelled as an 'abnormal woman'. In any case, the relevance of the 'Pygmalion effect' cannot be overemphasised whereby, people conform to the expectations that others hold for them regardless of their true characters or abilities (McGee, 1980, p.89).

5.8 Conclusion

To conclude, a lack of critical mass of women faculty in the institute and its departments creates problems described as 'tokenism'. Women are more noticeable, their mistakes get more highlighted and they are often excluded from informal socialisation. They are considered less suitable for academics and leadership. This perception reduces their involvement in administrative and academic committees. This creates a vicious circle of lower visibility and fewer interactions. Women scientists also seem to participate less in conferences and seminars, particularly at younger ages. However, mere increase in the number of women faculty may not change the situation because of the prevalence of patrifocal attitudes and sex role stereotypes. Due to such stereotypes, informal interaction, in the department and within the institute, is problematic for most women faculty members. The prejudices prevalent in the society are also reflected in its institutes. Women

academic scientists have rather low participation rates in the informal activities of the campus. This leads to a lack of contacts, a lack of visibility and isolation from group activity. The various sources of tension in the work environment create stress. This, coupled with the dual burden of managing home and career, creates a kind of triple burden. The nature and extent of this stress is discussed in the next chapter.

CHAPTER 6

CAREER STRESS AND THE DUAL BURDEN: IMPACT AND RESPONSES

6.1 Introduction

This study reveals the prevalence of various social biases against women academic scientists in institutions of higher learning and research. These biases and stereotypes work to the disadvantage of women academic scientists and lead to career stress. What is the impact of career stress on the lives of women academic scientists? These women scientists not only have job commitment but they also have a deep commitment to family. How do these women cope up with their multiple roles? Professional and family role lead to a dual burden. Career stress and a dual burden combine to cause a triple burden among women in this profession. This triple load has many consequences for women professionals including exhaustion, compromising their careers and social isolation. Multiple roles of a woman scientist and the resulting stress may also lead to a redefinition of 'success'. It is worth examining how such women scientists define success and its implications. This chapter addresses these questions and examines how women scientists negotiate their multiple roles.

6.2 Career Stress

The preceding chapters focus on the nature of problems resulting from the structure of the organisations, system of science, and unwritten norms existing in the profession that reflect the socio-cultural values prevailing in larger society. These problems are gender

related and lead to career stress. This, in turn, produces some negative effects on women academic scientists. My analysis shows that there are three major sources of stress among women academic scientists due to gender relations in the profession: (a) they have to work harder to prove themselves; (b) they feel isolated; and (c) they experience gender role dilemmas. The nature and extent of career related stress and their negative impacts are discussed in this chapter.

6.2.1 Women have to work harder than men to prove themselves

One aspect on which there was almost unanimity among the respondents was that women have to work much harder than men order to prove themselves. In the study a question was asked if women have to work harder than men in order to prove themselves. As many as 46% strongly agreed with the statement, 29% agreed, 13% agreed partly, only 11.8% disagreed, and none disagreed strongly. This indicates considerable agreement about the issue. During the interviews the respondents provided the following observations. Some of them are given below.

> Men feel that women are less committed. So they have to be two and a half times better than men to achieve similar recognition. (Respondent from Department of Electrical Engineering)
>
> Men colleagues, in trying to be protective, keep us away from some tasks since it may require going to the field or too much thinking. But it also implies that we are not at par. So we have to work very, very hard to prove ourselves. (Respondent from Department of Architecture).
>
> It is generally taken for granted by the men scientists that a woman cannot be as good as or better than them. So women have to work harder than men to prove themselves. (Respondent from Department of Electrical Engineering).

The reasons for women's need to prove themselves harder are discussed in the two previous chapters. Some of these explanations include the following: underestimation of women's work; stereotypes, which make it difficult for a woman to prove that she is at par with her male colleagues until she works much harder and produces work better than men

colleagues; and a lack of interaction and access to the informal sources of information through old boys' clubs and networks that make the work of women academic scientists less visible. Also, these women are less familiar with the ways of achieving success than men. About 47% of the respondents agreed that women are less familiar with the ways and means to achieve success in science than men, 27% partly agreed and 26% disagreed. This shows that women feel that talent is not sufficient to attain success. There are tacit and indeterminate elements in the habitus of the profession. Women are unable to share the habitus fully due to indeterminacy in the formal and informal environment of work (see Chapters 4 and 5).

Women's capabilities are doubted, especially initially. Hence, women have to work doubly hard than men to prove themselves as capable. Further the time required to professionally prove themselves may be quite long. As one respondent from Institute A said, 'I have been here for 16 years and it took 10 years to prove myself'. The perception that women are not given similar treatment as men and the need to work harder than men are two important reasons for career - related stress among women scientists.

6.2.2 Isolation in the work environment

Women are quite isolated in their work environment because informal channels of communications are less accessible to them. Women scientists lack women colleagues, women collaborators, and women administrators. About 70% of the respondents said that there are no women mentors. About 75% of the respondents felt that women colleagues are important but 47% said that there are only a few women colleagues and 12.3% said that they have no women colleagues at all.

Men colleagues usually form their own groups. Though women are not denied access to such groups, their presence, as reported by some respondents, is not welcome. Women are

also less incorporated in the old boys' networks. Even in daily activities like going to the offices of the colleagues and chatting with them is difficult since it might create rumours.

As mentioned in Chapter 5, about 58% of the respondents felt that male colleagues formed their own groups that excluded women scientists. About 69% thought that there was a dearth of persons with whom they could discuss professional matters or communicate research ideas. This was partly due to the lack of persons specialising in their field in the department and partly due to the distance from male colleagues. During the interviews at least 17 respondents actually mentioned that they worked in 'isolation' implying their inability to mix with the men in the work environment.

Some statements made by the respondents have already been cited in the earlier chapters that further substantiate this. For a lone woman in the department, the problem of isolation is severe. As one respondent from Chemical Engineering in Institute D said, 'I am the only woman in the department. It has a male culture. Men have their own tea clubs. I feel different and isolated. The colleagues talk very little with me and are very formal'.

6.2.3 Dilemma of being a 'woman' scientist

There is a strange dilemma which women face in this profession. This dilemma is that of reconciling their gender role with their professional role. Many respondents remarked that colleagues expected them to be submissive (a common expectation from women as a part of patrifocal ideology). Women who speak their mind or who are assertive are not considered as 'normal women'. As one respondent from Institute B said, 'women scientists are expected to be submissive and should agree to whatever they (men colleagues) say, otherwise it is considered unwomanly'. Another respondent said, 'people in this department are older and have a conservative mindset. They are not used to seeing a woman speak her mind or to

assert herself. Another respondent said, 'some men colleagues initially wanted to force their views on me; they thought that being a woman I should simply agree to their viewpoint'.

This problem of a typical mindset is more common in traditional engineering departments or in those departments that have relatively older male faculty members. It is supposed to be womanly to be submissive. Men expect women to behave like 'women' but when a woman faces a typical womanly problem such as pregnancy, it is frowned upon. At times the system and the colleagues are not very kind in such situations. This is brought out in the following statement of a respondent from Institute A:

> One woman faculty in our institute applied for maternity leave 22 years ago. She was denied on the grounds of a crushing teaching load. I did not face this situation but male colleagues were not happy when I took maternity leave.

Respondent from Institute D said:

> When I took maternity leave a second time, a colleague remarked that I had an advantage of being a woman since I could take three months holiday after every five years.

Neglect of women's needs such as separate toilet facilities, a proper security system (that is lacking even in the residential institutes), and inadequate childcare facilities portray the image of a system oblivious to the presence of women. The long period of hard work required to be professionally recognised, a lack of the system's sensitivity to women's special needs, isolation, and the gender related expectations and tensions are special sources of stress among women academics that arise from a gendered work environment.

6.3 Dual Burden

Women in every profession have to manage career and family. This presents a dual burden for women in academic science.

Historically, women have been primarily responsible for home and family. With the modernisation of society, women have been entering different professions in increasing numbers. However, women continue to assume their primary responsibility of managing the house and taking care of the children. Women who are professionally employed are working outside the home while at the same time doing a larger share of work at home than men – such as childcaring, cooking, and cleaning. Researchers show that women spend 50 to 70 percent as much time as men on paid work, but almost twice as much or more time as men on unpaid work (UN, 2000). The Time Use Survey conducted by Ministry of Programme Implementation, Government of India (2000), has also shown that females spent about double the time as compared to males in activities relating to taking care of children, sick and elderly people.

Thus, a woman plays a double role or dual role to play: one in the family and another in her occupation. This means that a working woman has to carry greater burden than a man because a man is not seen as responsible for domestic work and childcare. He is primarily a breadwinner. On the other hand, a woman's occupational role is not seen as something essential but as an 'added' role. Thus, home responsibility falls disproportionately on a woman. The double demands of the career and home leads to a double burden, which has been variously referred to as, 'dual burden', 'role overload', 'second shift' or a 'dual role syndrome' (Rout, et al., 1999; Hochschild and Machung, 1989; Chakravarty, 1986; Hirsch and Rapkin, 1986;).

The demands of pregnancy, motherhood, and a joint family lead to instability in a woman's career. Pregnancy and care of the newborn affect scientific research at a time most crucial to a woman's career. In India, a married woman has a commitment of taking care of her in-laws as well. If a woman is residing with her in-laws, an understanding with them is

essential. Otherwise it breeds another source of tension. Like men faculty members, women perform the professional role of teaching, some research and administrative tasks (if assigned). Unlike men, women are also responsible for household tasks and the care of children and old parents. This is the 'dual burden'.

Respondents were asked whether women bear the dual burden of homemaking and job. About 92.2% (71) women answered in the affirmative. A majority (51.9%) of the respondents felt 'stressed out' at the end of the day. About 13% said that they found it 'extremely difficult to cope', that they were over-tensed and have a feeling of not being able to do justice to either their home or career. About 19.5% of the respondents have become habitual and since their children have grown up, it is easier to cope. The remaining 15.6% (12) respondents are single women. Of these 12 single respondents, 9 said that the term 'dual burden' did not apply because they are not married, and 3 said that though they were single, they have to look after both house and profession which is a source of stress.

6.4 The Effect of a Dual Burden on Careers

Marriage, motherhood, living in a joint family and managing the house involves time and effort that, if combined with a career constitute a dual burden. This section discusses the effect of a dual burden on the career of women academic scientists.

6.4.1 The effect of marriage and motherhood on career

Marriage increases the social obligations of a woman because she has to interact with a larger circle of friends and relatives. Relatives of the husband need to be given special attention, which is a reflection of patrifocal value system. Migration from a place of work (where a woman is employed before marriage) to another due to marriage also affects

careers. Table 6.1 shows the frequency distribution of respondents according to their perceptions of the effect of marriage on their careers.

Table 6.1: The Perceived Effect of Marriage on Career

Item	Agree	Partly agree	Disagree	Total
Marriage affects career because of migration from earlier place of work to another	54.7	36.0	9.3	100
Marriage affects career because of added social obligations	68.0	25.3	6.7	100

Table 6.1 shows that the majority (54.7%) of the respondents agreed that marriage affects the career of a woman professional due to migration from earlier place of work to another. The table also shows that 68% agreed and 25% partly agreed that marriage affects careers because of added social obligations.

Various studies have found that educated and high income women are in an excellent position to balance a demanding career and family life. As Sylvie Carrier (1995) puts it, the education, income and social network provide such women with a number of possibilities, which increases their capability to reconcile different roles. This is particularly true of working women in India where domestic work can be delegated to paid help. However, these advantages are outweighed by the traditional mindset about stereotype roles of men and women. While in the West, sharing household tasks between the spouses might be an accepted norm, in India it might be frowned upon if husband helps in such tasks. For instance, one of the respondents said, 'When my husband helps in cooking and washing dishes my in-laws do not like it.

Paid help is not as easily available in metropolitan cities as in smaller cities. Even if the paid help is available at home, it is not secure to leave an infant with that help because

she/he is likely to be illiterate and untrained. Facilities for childcare in the institutes are dismal. Crèche facilities exist in some metropolitan cities but they are still not popular.

Thus, motherhood brings a heavy responsibility for childcare, which has to be shouldered by a woman. The period of pregnancy and motherhood lead to a break in career and a neglect of research. For still an extended period, travelling for conferences or some other assignment becomes extremely difficult (See Chapter 5).

In our sample, about 53% of the respondents agreed that motherhood leads to a decline in scientific productivity such as writing research papers, project reports, etc. But the respondents disagreed that it leads to a decline in job involvement. About 36% agreed that it brings a decline in job involvement. Five respondents reported a break in career, ranging from one to five years due to motherhood. The loss of these years is not lamented, since in India, motherhood for a woman is universal and brings social respect. But as one respondent said, that loss of these years pushed her lower than others who were on the same level as her. Others got promotions earlier than she did, for example.

It may be pertinent to compare the average level of research activity of the married with those who are single / divorced / widowed. Table 6.2 shows that married women are equally or more productive in terms of research activity compared to the single women.

Table 6.2: Average Research Output (per year) by Marital Status of Respondents

Marital status	Average number				
	Journal papers	Participation in Indian conferences	Participation in International conferences	Indian conference papers	International conference papers
Married	1.70	1.63	0.41	0.99	0.6
Married and no child	1.60	1.88	0.77	1.40	1.00
Married with children	1.72	1.4	0.39	0.98	0.58
Single/divorced/ widowed	1.44	1.36	0.38	0.86	0.66

Table 6.2 shows that research activity of married women is higher in terms of the average number of publications and participation in conferences compared to those who are single/widowed or divorced. This shows that despite a dual burden, women scientists conduct research. Probably the social system is more favourable for them than for the single women. Single women are more isolated socially than the married. Their interaction and collaboration with men scientists suffers so that they are less prolific research workers than married women. Those who are married with no children are more mobile and write more conference papers. However, their journal publications are lower than those with children. The fewer publications of married women with no children can be explained by the fact that half of them are from architecture and almost all are in their early 30s. While research papers in the field of architecture are usually lower, those who are young have not developed sufficient contacts and collaborations for doing research. As mentioned in the previous chapter, those in the older age group have a higher number of average publications.

6.4.2 Effect of joint family on career

About 14% (10) respondents have lived with in-laws at some stage of their life. Eight respondents are still staying with their in-laws and two stayed with them when they were young. The pressure of the joint family has an adverse effect on the career and is a source of stress among many. This is evident from some responses. According to one respondent, 'I did my doctorate after marriage. But my in-laws did not give any weightage to my research. Hence I faced lot of family problems. And my Ph.D. got delayed.'

Another respondent who is now no longer living in a joint family said that she had a tough time when she was staying in a joint family. There was too much pressure of work and she was tense all the time. She also had to follow various customs and rituals for *'grihashanti'* (peace in the house).

There are some cases in which women academics had very co-operative in-laws, who took care of the children when they were young and they felt free to do their research or to travel. For example, when a respondent went abroad as a visiting scientist, she left her child behind and the mother-in law took care of the child. The extended family structure provides support for these women in terms of childcare. However, living in such families has its own problems. Such families sustain traditional gender roles. In-laws do not like to see the spouse help in household work. Various traditional rituals including fasts may have to be performed to please them. This is further substantiated in a following section.

6.4.3 Domestic help and the role of the spouse

As seen in an earlier section, for a majority of women there is stress and to reduce it time management is their primary strategy. All the respondents have paid help to help them in household chores. Very few have in-laws staying with them, the rest depend entirely on domestic help. The majority of the respondents has full-time paid help or more

than one help. In spite of this, many household tasks are unavoidable, such as overall house management, care of children, marketing, and some cooking, in the decreasing order of the number of responses. In this context, the role of the spouse becomes crucial. It is encouraging to note that the majority of the respondents (53.2%) said that they got the co-operation of their spouse in domestic chores; only 16.9% said a categorical 'no' to receiving any such help; 6.5% said they got very little help. Spouses of 3.9% do not stay with them. The rest (19.5%) are single, divorced or widow. Thus, out of 62 currently married, 41, that is, 66% received some sort of help and the rest received little or no help. However, it is important to note the nature of help given by the spouses. Table 6.3 presents data on this aspect of help.

Table 6.3: Frequency Distribution of Respondents by the Nature of the Spouse's Help

Activity	Number	Percent
Childcare	6	14.6
Cooking	1	2.4
Help in everything	19	46.3
Help in professional matters	5	12.2
House management	2	4.9
Marketing	22	53.7
Total	55*	134.1

* Total exceeds 41 due to multiple responses.

Table 6.3 shows that of those who received help, 46.3%, said that the spouse helped in everything that they did (multiple responses were not given by such respondents). They form one third of the currently married respondents. Among those respondents whose spouses shared in all tasks, 7 are in their 30s, 6 in their 40s, 5 in their 50s and one in her early

60s. 14.6% got help in care of children, 2.4% in cooking, 12.2% in professional matters such as purchase of computers, writing official letters, etc and 4.9% in house management. 53.7% received help in marketing. Marketing for daily household goods in many parts of India is usually done by men and is accepted as 'men's work'. These figures show that while a majority of the respondents do not receive substantial help at home, there are at least one-third whose spouses share in all the household tasks. Analysis also shows that sharing is not limited to a particular age group. Women whose husbands share their work belong to all ages.

It may be noted that the encouragement and help of the spouse is crucial in the success of women's career. As one respondent said:

> My husband always inspires and helps me. In fact, being a computer professional, he helped me in programming of my Ph.D. work and relieved me of all household work so that I can submit my Ph.D.

Another respondent commented:

> My husband taught me how patience, confidence and constant striving can help in attaining one's goal.

On the other hand, some respondents have compromised their career after marriage in a major way. One respondent specialises in a field which has a number of openings, and planned to join an institute outside her city after receiving a Ph.D. But after marriage she joined the institute that was the best in the city of domicile since her husband worked in the same city. The institute did not have her field of specialisation and she had to compromise by joining a department that was close to her specialisation.

As mentioned in Chapter 3, a substantial percentage (39%) married below the age of 25 years. For these women career in academic science began after marriage. Those who joined service in the institute after marriage are 76% (51). The decision to join academics indicates an attempt to balance career and family life, since an alternative job requires a greater number of hours outside the house than a teaching one. The academic profession has

the advantage of flexible work hours. Even engineering graduates who could take up any industry job also join academics after marriage despite lower economic returns and a prolonged period of studies. As many as 59% of the 39 engineers in this study took up this profession after marriage. Figure 6.1 shows number of respondents joining an institute before and after marriage. The respondents falling in the '+' side of the graph indicates the number of respondents who joined before marriage, and those falling in the '-' side joined after marriage. A larger area is covered by respondents in the '-' area of the graph. This shows that a majority of the respondents joined after marriage.

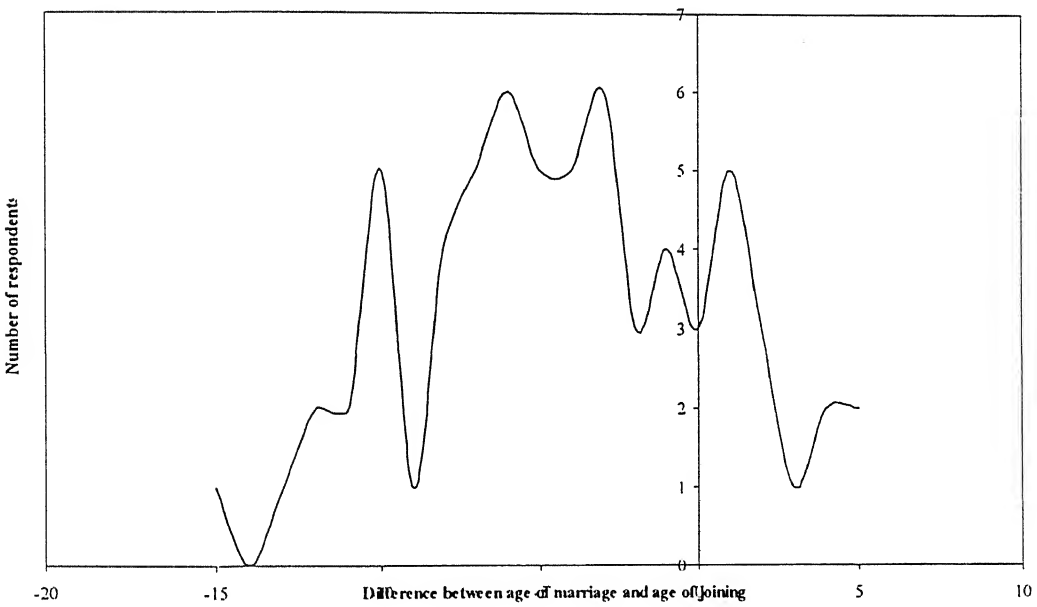

Figure 6.1: Number of Respondents Joining an Institute Before and After Marriage

Among 51 of the respondents, who joined the institute after marriage, husbands of 43% (22) respondents work in the same institute. This also indicates a preference among

highly qualified women for jobs that do not disturb family life. At the same time, the support of a spouse in joining the academic career has been a crucial factor among the respondents.

Thus, there is no simple conclusion regarding the role of the spouse. Several patterns emerge. A majority of the spouses do help but the tasks do not involve substantial co-operation in the household work. One-third of the spouses help in everything, which represent greater respect for women and their profession and the emerging changes in the role stereotypes prevalent in the society. Encouragement and co-operation of the spouse seems to be there for the academic career. However, since very few respondents are staying alone, there is a preference among the respondents for joining a job, which is in the same city, even if it means changing the field of specialisation.

6.5 The Impact of Career Stress and a Dual Burden

Among the women professionals, a gendered environment at the workplace is a source of stress. But this alone is not the cause of tension. Like women in any profession, women have to negotiate professional and domestic roles, which is a dual burden. Thus, career stress and dual burden together may be defined as a 'triple burden'. This triple role overload has various kinds of repercussions including a compromise in career, physical, mental and emotional exhaustion, a lower position on the ladder of success, problems of identity, and isolation outside the workplace also. These aspects are examined below.

6.5.1 Compromises in career

In some cases family responsibilities and career stress have directly stunted the growth of women's career in academic science. Such respondents have given primacy to their family responsibilities. These responsibilities have prevented them from making use of some

important opportunities that came their way. In this sense the dual burden has acted as a barrier in the advancement of their career.

One respondent who could not avail of some opportunities because of family responsibility said:

> I got fellowships under two schemes from Germany and one from Norway. I was invited as a visiting scientist at UK. But I could not go abroad because my family needed my attention.

As mentioned in the previous chapter, visibility and contacts are essential in this profession and this requires travelling. Women are unable to travel due to family responsibilities. In this context, a respondent said, 'I was invited to be a key speaker at Darjeeling, but I could not go because of my child'.

Thus, family and career roles lead to a dual burden, which is a source of stress. The essentiality of the family role compels many women to compromise their career and in the process to forego some important opportunities for career advancement. Many women consider it their duty to give primary importance to the family. But the tendency to give primacy to family reflects successful internalisation of the norms of society. As one respondent said, 'my career has been affected by my conscious decision to give time to family. Yet I have no regrets'. Three respondents admitted that they are not involved in any research. They are quite aged and have worked primarily as teachers. Even though they were brilliant in college, they did not pursue research because they had no time for it due to family responsibilities.

6.5.2 Exhaustion

A triple burden leads to exhaustion. Multiple roles lead to efforts at time management and rigorous self-discipline, which sometimes leads to a feeling among women that life has become mechanical. Most respondents are exhausted physically, emotionally, and mentally at

the end of the day. This is evident from the responses to the scale of tiredness. Respondents were asked, 'How often do you feel that pressures of being a scientist and a homemaker makes you tired?' They were asked to answer on a five-point scale ranging from 1 (never) to 5 (always). In the table a higher value of mean shows more stress.

Table 6.4: Degree of Stress due to Triple Burden

Statement	Average	S.D.
Degree of tiredness due to pressures of being a scientist and a homemaker:		
a. physically	3.32	0.88
b. emotionally	2.72	1.07
c. mentally	2.67	1.07
Feeling that life has become mechanical	2.65	1.08
Overall	2.90	0.11

Table 6.4 shows that on an average respondents feel tired physically more often than emotionally or mentally. It may be noted that there is a greater diversity regarding feelings of emotional and mental tiredness rather than physical tiredness. This is due to the diverse organisational and departmental settings in which the respondents work. The average score for the statement that 'life has become mechanical' is 2.65 which shows that a majority of the respondents feel so at least sometimes.

6.5.3 Position on the ladder of success

Problems of managing triple burdens have an effect on the extent to which women can attain success in a particular time frame. In the similar time frame, men can probably reach higher on the ladder of success. Success in academic science means attaining the highest position in the hierarchy of the organisation and wide recognition for one's research in the national and international community.

The respondents were asked the following questions in the interview:

> Imagine there is a ladder of success. On its first step is the least successful scientist and on the tenth is the most successful one. Where will you place yourself?
> Where would you think you would have been if you were a male?

The respondents' perception of their position on the ladder of success is shown in Table 6.5.

Table 6.5: Distribution of Respondents According to their Perception of their Position from 1 (Lowest) to 10 (Highest)

Position	Number	Percent
1-3	7	9.2
4	4	5.3
5	18	23.7
6	16	21.1
7	15	19.7
8	11	14.5
9-10	5	6.5
Total	76	100

This table reveals that about 38% of the respondents place themselves at 5 or below. A large percentage, about 40.8%, place themselves between 6 and 7, which is a sign that they are still struggling. Those (14.5%) at position 8 consider themselves fairly successful. About 6.5% feel that they are at the top. Three respondents placed themselves at number ten also. This indicates that they have fully achieved what they wanted to achieve and have a sense of fulfilment. Thus, the ratio of those who feel that they have attained considerable success

(subjective position of 8 to 10) is only about one-fifth, the majority is either struggling or still has a long way to go.

In answer to the question on their position if they were male, a majority, that is about 59.7% (46) of the respondents, felt that they would have been at a higher position: 53.2% (41) respondents said that they would have been two or more steps higher than their position now if male; 6.5% (5) said they would have been one step higher. About 32.5% (25) said there would have been no difference. Ironically, there are some respondents (5.2%) who said that they would have been at a lower position if male (two were non-responses).

It is interesting to analyse why some respondents felt that they would have been at a lower position if male. Their explanations give insights in understanding the effect of gender on scientific work. One respondent from Institute B said:

> If I were a man, I would have spent lot of time in having tea or gossiping. I have learnt to compartmentalise my time and mind.

Another respondent from Institute C said:

> A man would not have been able to utilise his time as creatively as I have in trying to achieve maximum in the least possible time.

Both of these responses show that the respondents actually perceive the disadvantages of being women and are trying to compensate by reducing leisure, compartmentalising their activities or through extra hard work. They seem to be looking for higher self-esteem.

The majority who felt they would have been at a higher position if male gave mainly two reasons. One, they could have spent more time in research which they could not due to family constraints. Two, they face many gender related problems in the work environment. Being a woman in this male dominated profession is a disadvantage, which can be overcome only through very hard work and support of the immediate family members. Those who said there would have been no difference are of two types; those who are quite successful and

think that as a man they could not have gone higher; and, those who have just started their career and till now have been able to achieve their goals (publications, promotion, etc.).

The difference in position if male and present position as perceived by the respondents is the index of relative deprivation or perceived gender bias. The mean difference between the two scores is 1.90 which clearly exhibits a sense of relative deprivation among women scientists. To unearth the pattern of relative deprivation or perceived gender bias the index of relative deprivation was regressed on three factors: age (a demographic characteristic), marital status (another demographic category linking women to family), and designation (status in organisation). A small number of cases (N=70) does not permit the researcher to include more predictors (variables in the regression). According to Tabachnick and Fidell (1989), ideally one should have 20 times more cases than variables. Table 6.6 presents the correlation matrix for these four variables. It shows that the perception of gender bias is significantly correlated with designation (one tailed p=.025). Among the independent variables, age and designation are highly correlated (one tailed p=.000). All other correlations are insignificant.

Table 6.6: Correlation Matrix

Pearson's correlation	Index of perceived gender bias	Age	Marital status	Designation
Index of perceived gender bias	1.000			
Age	-.067	1.000		
Marital status	.163	.091	1.000	
Designation	-.236*	.582**	.032	1.000

N=70

* p=.025; ** p<.025

The multiple regression analysis shows that the perceived gender bias as a linear function of age, marital status and designation may be expressed as follows:

$$PGB = 1.560 + .02696\ AGE + 1.272\ MAS - 1.515\ DES$$

$$(R^2 = .090)$$

where PGB refers to the perceived index of gender bias and AGE, MAS and DES refer to age, marital status and designation. Age is measured in exact years. Marital status (ever married = 1, unmarried = 2) and designation (lecturer and assistant professor = 1, associate professor and professor = 2) are dichotomous variables.

A low value of R^2 (F-ratio for the model is 2.170 which corresponds to a p-value of .100) shows that the regression line does not predict the perceived gender bias (the criteria) well. Tests of significance show that only designation has a significant regression coefficient (Table 6.7).

Table 6.7: Regression Coefficients and their Significance Level

Model	Unstandardised coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	1.560	1.861		.838	.405
Age	.026	.045	.087	.603	.549
Marital status	1.272	.914	.164	1.393	.168
Designation	-1.515	.749	-.292	-2.022	.047

N = 70

The table shows that partial regression coefficients of age and marital status are statistically insignificant. Thus, one can infer that women academic scientists who are junior in designation have a significantly higher perception of gender bias than the senior academic

scientists. This inference of multiple regression analysis is consistent with the findings of the qualitative data on the issue of informal communication (Chapter 5).

The higher perception of gender bias among junior women academic scientists may be due to the fact that they are still in the process of establishing themselves and they feel the biases more acutely since it may directly affect their work efficiency. The seniors have already attained a status and at a higher level the biases may not be so apparent. Designation remaining the same, older women scientists and married women scientists perceive more gender bias than others but their coefficients are not statistically significant.

One of the important findings of this study is that despite the double burden and problems women scientists face, they are very ambitious. They have considerable expectations from their career. Most of them want to attain recognition and fame (36 respondents). They also want self-satisfaction in whatever they do. Some want to set their own example through hard work and prove that women are not any less than men. A few advocate social change and desire to teach the illiterate or create some product that will be beneficial in the villages.

6.5.4 Identity problems and isolation outside the work environment

The earlier section on the dilemma of a 'woman' scientist discussed their problems due to conflicting perceptions in the workplace. Here the discussion is centred on the conflict of identities that women experience within themselves due to their own perceptions. Most women scientists experience a conflict of identity in this profession. The conflict is one between the identity of being a woman and a scientist. The term 'scientist' seems to exclude the identity of a woman. In other words, identities of a 'woman' and of a 'scientist' are mutually exclusive. This comes out from the responses to the following question in the

interview: 'In community living would you identify more with the scientist, women or you feel different?' To the above question, a majority, 53.2% (41) of the respondents said that they would identify with both, scientists and women; 27.3% (21) with scientists; 10.3% (8) with women; 5.2% (4) said they felt different from both; 2.6% (2) with scientist and mother. One identified herself with teachers only. The fact that a majority identified themselves with both women and scientists indicates that the respondents perceive two roles as essentially different if not contradictory. If a similar question was asked of a male scientist, perhaps he would have identified himself only as a scientist and not as a man and a scientist.

In response to this question on identity, respondents made some comments that reflect their perceptions. For instance, one respondent from Institute A said, 'we are not different but people think we are different'. This indicates that even though they would like to mix with different people in the campus, others are hesitant to interact. Another from Institute B said, 'I can't mix with the housewives. Women don't know how to treat me and they feel uncomfortable in my company'. This statement reflects a social distance created among the same gender group due to a professional career. Some do not face any ambiguity in their identity as reflected in this statement: 'in social gatherings I identify myself with women and in professional gatherings, with the colleagues'.

Outside the workplace women scientists usually lack time to socialise or interact with others. Hence, they do not socialise much. In social gatherings, especially in the campus setting, they have to interact with men colleagues and their spouses. Many of the respondents said that they found it difficult to interact with the wives of men colleagues. Sometimes the spouses of men colleagues felt that women scientists were 'different' and were hesitant to mix. Also, some women scientists felt it difficult to take part in the conversation with women other than professionals. Many of them would be comfortable in the group of professional

colleagues but in the social gatherings there are usually separate groupings of men and women. Hence they feel isolated in such gatherings.

6.6 *Organisational Differences in the Triple Burden*

The IIT system is known for the importance attached to high quality research and a need for a good research background to rise in the academic hierarchy. There is also a commitment for quality in teaching. Thus, expectations from the faculty are higher in these institutes compared to the universities. This implies greater pressure on the faculty to perform well. This pressure coupled with the work environment can be expected to exert greater career stress on the women faculty. This became clear during the interviews.

During the survey the average of agreement by the respondents to two statements on a five point scale was computed (1 shows strongly disagree, and 5 strongly agree). A higher mean score implies higher degree of agreement.

1. Women have to work harder than men do in order to prove themselves.
2. Women are less familiar with the ways and means to achieve success in science than men.

The average score on the first statement given above is 4.53 for the IITs and 3.89 for the other two institutions. The same scores for the second statement are 3.48 and 3.35 respectively. They indicate greater difficulty of IIT women faculty in attempting to prove themselves. The feeling of being less aware of the process of attaining success is also greater among the IIT respondents.

It seems that the contacts of respondents at IITs are higher than those at universities. The average response to the statement 'women scientists are less successful because they lack contacts and networking' is 2.94 for IIT respondents and 3.3 for non-IITs. Thus, compared to

the respondents at IITs, those at non-IITs showed a higher degree of agreement with the statement that women are less successful because of a lack of contacts. This shows that respondents of non-IITs lack contacts.

Stress due to a triple burden also appears to be greater on IIT women (Table 6.8). The difference is more marked in physical tiredness and in feeling an inability to reduce the pressures of scientific practice. This is indicated from the responses to the scale of tiredness discussed earlier. They were asked to answer on a five-point scale ranging from 1 to 5. In Table 6.8 a higher value of tiredness shows more tiredness (between 1 for never and 5 for always).

Table 6.8: Degree of Stress due to Triple Burden: IITs vs other Institutes

Statement	Overall	IIT	Non-IIT
Degree of tiredness due to pressures of being a scientist and a homemaker:			
a. physically	3.32	3.4	3.26
b. emotionally	2.72	2.77	2.7
c. mentally	2.67	2.74	2.61
Feeling that life has become mechanical	2.65	2.73	2.61
Feeling powerless to reduce the pressures of scientific practice	2.31	2.5	2.32

6.7 The Impact of the Regional Context of the Institutes

As mentioned earlier, UOR is situated in Roorkee that is north of Delhi, IIT Delhi and JU are in the metropolitan cities of Delhi and Calcutta, and IIT Kharagpur is situated in a small town of Kharagpur near Calcutta. The regional impact is seen not only on the organisation but it also has ramifications for the women academic scientists.

The Kharagpur and Roorkee campuses are isolated from the city. Hence, employment opportunities for the partner are limited. Also, since the respondents are isolated in the work environment, isolation from the city as well multiplies this feeling. As one respondent said, 'the problem of isolation is enlarged'. On the other hand, being part of the city, in IIT Delhi and JU, faculty and students have activities outside the campus, but it also implies a lack of serious commitment towards the activities on the campus. A big city environment means more stress since life is more hectic. At the JU, residences of the faculty are mainly outside the campus and commuting long distances in the city implies greater expenditure of time and energy. Being outside the campus may have other consequences as well. As one respondent said, 'because I stay outside the campus, I build up less contacts, which means that I don't get invited to be on the committees and I lack overall visibility'.

The impact of northwestern culture in Delhi and Roorkee is obvious, while impact of the culture of West Bengal is seen on IIT-Kharagpur and JU. Respondents from the northern Indian institutions felt that respect for women is lower and there is a greater conservative attitude towards women here than in other parts of India. Respondents from West Bengal said that while there is greater respect for women and higher education of girls is considered desirable, the work culture on the whole is not strong. Due to this, time management for the respondents becomes difficult. In one institute a great impact of political parties was seen in day-to-day working of the institute, such as, in appointments and promotions of the faculty members. This becomes another source of stress among women academics in particular.

6.8 Redefining 'Success'

The women faculty members in our sample are committed to their job. They are talented and have a tremendous liking for science. At the same time they have extra

professional roles (domestic role) also, towards which they are equally or more committed. This reality has led the respondents themselves to redefine 'success'. In this section the nature of respondents' involvement towards the profession and science is examined and is then followed by a discussion of their definition of success.

Given below (Table 6.9) are statements which are coded on the scale of job involvement ranging from 1 to 5, from strongly disagree to strongly agree. Statements C and D have been given reverse codes because they reflect a lack of job involvement. Thus, for these two statements code of 1 indicate strong agreement and 5 indicates strong disagreement. A low value of a grand mean implies disagreement on job involvement and a higher value of an overall mean reflects high job involvement.

Table 6.9: Degree of Job-Involvement

	Statement	Average	S.D.
A	Most of my interests are centred around my job	3.75	1.04
B	Most of my personal life goals are job oriented	3.24	1.20
C	To me my job is only a small part of who I am	3.14*	1.15
D	Usually I feel detached from my job	4.15*	0.65
E	I live, eat and breathe my job	2.28	1.07
F	I have strong ties with my job which would be very difficult to break	3.78	1.03
	Overall	3.39	0.19

* Actual scores of C and D are 2.86 and 1.85.

The grand average of 3.39 indicates that there is job involvement though it does not appear to be of a very high degree. This is because of extra-professional concerns in their life, which relate to family. The actual scores for C and D show that the respondents disagreed with the statements on a lack of job involvement. For women, academic science is a career. Yet, it cannot be the sole purpose of their lives. While a man can assign family responsibilities to their wives, and can have a 'one-dimensional focus' on their career, women usually want 'multi-dimensional lives' (Pattatucci, 1998, p.133). Women would not like to sacrifice family

for career. As one respondent from Institute B said, 'a woman should not destroy her family for career'. Further, Indian social norms consider marriage and motherhood as a woman's *'dharma'* (sacred duty).

Though the degree of job involvement is not high, there is a strong degree of job satisfaction (See Table 6.10). The respondents were asked to respond to the five point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Statements D, E and F have been given reverse codes because they reflect a lack of job satisfaction. A higher value of grand mean indicates a high level of job satisfaction.

Table 6.10: Degree of Job-Satisfaction

	Statement	Average	S.D.
A	I find real enjoyment in my work	4.25	0.91
B	I feel fairly well satisfied with my job	4.30	0.65
C	Most days I am enthusiastic about my work	4.17	0.80
D	I feel that my job is not more interesting than others I could get	3.63*	1.13
E	I am disappointed that I ever took up this profession	4.41*	0.73
F	Most of the time I have to force myself to go to work	4.51*	0.64
	Overall	4.21	0.19

*Actual scores of D, E and F are 2.37, 1.59 and 1.49 respectively.

The grand average of 4.21 shows a high degree of job satisfaction among the respondents. Thus, even though women academic scientists are not highly involved, they are satisfied with the job.

An overwhelming percentage of women (92%) rarely or never thought that they do not belong to science. With their dual commitments - towards family and science - their definition of 'success' is quite different from those of male scientists. For a man, to be successful would mean professional recognition, awards, and highest honours. Women scientists in our sample seem to think differently about success.

Respondents were asked about their definition of a 'successful woman' in the interview. Most respondents (80.5%) feel that a successful woman is one who can balance both home and career. About 75% (58) feel they are successful, 20.8% (16) said they are trying and only 3.9% (3) said they do not consider themselves successful. Out of 58 who considered themselves successful, 44 said they have been able to balance both; 4 said they are successful because of being professionally successful, and the rest were satisfied with whatever they have achieved. But there is a subtle hint of having compromised on the career or home front. Out of three who said they are not successful two have not done well professionally and one said that since she is single she does not consider herself to be successful.

The above definition of success, which balances both commitments, is problematic due to one reason. It seems to imply a compromise on the career front or a career of limited ambition. White (1973, p.577) suggested an alternative career model for women in science. This model might be represented schematically by 'an ascending spiral movement, indicating career choices, which are upward in direction, but slowly paced with long horizontal stopovers'. The primary aim of such a career would be intrinsic satisfactions, greater esteem and not greater status or extrinsic rewards. However, such a model seems to imply that there are basic psychological and sociological differences between men and women. There are dangers in focussing on such differences. To follow James (1997), beliefs about differences have real consequences that perpetuate exclusion and dissimilar circumstances. By focussing on difference we reinforce stereotypes and biases.

The evidence from our sample clearly shows that in their career plan women scientists would like to accommodate a family as well. But the extent to which they compromise with

career or family is perhaps a matter of personal choice. The point is to *have* a choice, to be able to decide one's choices in life without social pressures.

6.9 The Positive and Negative Impact of Science on Personal life

Science and its practice involve the use of scientific method, a method of acquiring knowledge involving verification of hypotheses through observations and tests. It 'does not postulate unconditional truths but truth-hypotheses valid for a range of specified conditions' (Krishnaraj, 1991, p.187). It generates some amount of scientific temper or rationality. This attitude rejects *a priori* assumptions, prejudices, beliefs and superstitions. An attempt was made to study the impact of science on the daily lives of the highly educated women professionals. While a dual burden is one of the impacts there are others as well which could be positive or negative.

All respondents agreed that science has contributed in some positive way to their life. A majority believed that it has made them more analytical and logical. Following are the positive influences stated by them in descending order of frequency of responses:

- it has made them more logical and rational. (53 responses)
- they have become more systematic, methodical, and learnt to manage time. (8 responses)
- they tend to think scientifically in everything and this helps to solve problems of daily life. (15 responses)
- it has brought greater confidence and a positive outlook. (19 responses)

Respondents were also asked if they think that science and its practice had a negative effect on them. While 60% of them said there was no such negative impact, the rest felt that

there were some negative impacts too. Given below are the negative impacts of science on women in a decreasing order of frequency of responses:

- others (old relatives and 'in-laws') are irritated by use of scientific logic in everyday practice. (14 responses)
- work is very demanding, there is too much pressure of work, long hours of work are involved. (6 responses)
- dual burden of job and family has taken toll of their health, brought anxiety and worry. (5 responses)
- society hesitates in interacting with them. (4 responses)
- problem in marriage (1 case);
- 'I am not worldly wise' (1 case).

Out of 31 respondents that said the above, a majority (19) are from the IITs and rest (12) from the two universities.

Science and higher education in general should help to broaden the vision and question those customs that are a manifestation of a patrifocal value system. Women in different communities in India follow a variety of customs and traditions, which reflect the supremacy of the male members and the subordination of women. Observance of certain fasts, for instance, are 'unscientific as well as derogatory to women...'(Krishnaraj, 1991, p.191). Many of them are observed to ensure the welfare of the husband or son.

The married respondents were asked if they follow the customs of their community. About 56.6% of the respondents do not follow any custom or ritual and do not keep any fast. About 11.8% do not keep any fast but may do some ritual 'puja' (prayer) customary on some auspicious day. Various reasons were given for not keeping a fast: a large number of respondents (41.9%) had no belief in them; 16.2% said they are inconvenient to follow

because they have no time, and it affects their health; 8% felt that these customs are irrational and; the rest said that they are not 'religious'.

Only 16% kept ritual 'vrats' (fasts) or did elaborate 'puja'. The reasons were the following in the decreasing order of the number of responses (the total percentage is higher due to multiple responses): they believed in them (14%); they followed only to please their mother-in-law (6.7%); they did so for their own peace of mind or to bring some change in the routine of life (4%).

Thus, a majority of the respondents does not keep any fast and some of those who observe them do so out of their own choice and for reasons that have nothing to do with religion. This suggests that science and higher education are able to rationalise attitudes and encourage breaking out of the traditional mould.

6.10 Conclusion

To conclude, women in academic science are deeply committed to science and have a sense of involvement in their profession. However, the structures of organisations and profession, and cultural stereotypes in the profession lead to career stress. This stress has various dimensions. One, women in this profession work in relative isolation; two, they have to work harder than men in order to be treated at par with the men colleagues; three, they find it difficult to deal with woman related problems. They also have a commitment to their family and have to manage both career and family. This leads to a dual burden.

The impact of a double burden and career stress results in a sort of triple burden. In dealing with these multiple sources of stress, women academic scientists may compromise their career, remain satisfied with a lower status in the profession, and face social isolation. Due to an equal commitment to family and job, women consider those women successful

who can balance both. There are greater chances of a career being compromised than the family in this process of balance. Our social structure places a high premium on women's family roles. The choice of what one would like to compromise lies with the individual woman but the fact is there is only one choice; that is, compromise one's career until career related stress and the dual burden are reduced.

CHAPTER 7

SUMMARY AND CONCLUSIONS

The study has developed a new conceptual scheme to study the problems of women academic scientists. The method of triangulation is used to develop a comprehensive picture of the work environment. This chapter includes the conceptual scheme, a summary of objectives, research methods and findings. This is followed by a brief discussion of the implications of the findings to improve the environment for women scientists. At the end I discuss the limitations of the study and suggests how these problems can be overcome in research on the subject in the future.

7.1 The Problem

Women in science are very few in number. Since the beginning of modern education in India, science education and professions have been dominated by men. Even now women form only about 20% of the total enrolments in science and engineering education. The proportion of women scientists in teaching and research in reputed institutes of science is even lower.

The primary aim of this study was to examine the social, organisational and institutional environments in which the women academic scientists work. It attempts to reveal their experiences in this profession and to explore if the conditions under which the women academic scientists work are similar to those of men faculty members and whether they are able to utilise their potential to the fullest. In the dominant Mertonian framework in the philosophy of science, science is considered to be 'universalistic',

rewarding merit without any biases and prejudices. One of the aims of the study is to find out if universalism operates in the case of women scientists. The effect of work and social environment on their career is also investigated. Social stereotypes about the roles of men and women are important factors that cause low participation of women in science and engineering. Stereotypes infiltrate the workplace and the lack of a critical mass complicates the situation further. As a result, women faculty has to face overt and covert discrimination. Gender biases along with the dual burden on women scientists create an extra source of stress among women in academic science.

7.2 Objectives

The main objectives of the study are as follows:

1. To study the background of women academic scientists in selected institutes of higher learning and research.
2. To explore the nature of the formal environment of work and its impact on women academic scientists.
3. To study the importance of and participation in informal activities, contacts and networking by women in academic science.
4. To study the perception of women academic scientists regarding the presence of gender bias in the institutes.
5. To study if there is a gender related stress on women academic scientists at the workplace.
6. To study the impact of multiple roles, including work roles and domestic roles, on the career of women academic scientists.

7.3 Conceptual Scheme

This study begins with a new conceptual scheme developed on the basis of the available literature in three fields of sociology: sociology of science, sociology of professions and gender studies. Merton claimed that the institution of science is universalistic. From this point of view, particularistic criteria of race, nation, religion, class or sex are irrelevant in accepting or rejecting a scientific claim and in rewarding scientific contributions. Post-Mertonian writers, such as Kuhn, showed the relevance of scientific communities and communications within them for acceptance of knowledge claims and recognition. Knorr studied the technical culture of research locales and indicated the importance of non-technical resource relationships. Mulkay and others suggested that scientists belonging to different specialities might form networks for academic gains. The study found the concept of 'networking' and 'scientific communities' quite useful in understanding the process of particularism in science. Informal communications and contacts among scientists are important in the process of knowledge production. Looked at from this perspective the present study reveals the perceptions of women scientists regarding the nature of science and the importance of networking in the profession.

A combination of sociology of science and sociology of professions led Atkinson and Delamont to suggest the concept of 'indeterminacy' in professions that helps to reveal the marginal status of women in science. Indeterminacy refers to certain hidden aspects, informal rules and unspecifiable aspects of any profession apart from its codified part (or 'technicity'). The 'indeterminate' aspects of a profession act as subtle barriers for women

academics. This is a useful conceptual tool to analyse the work environment of women academic scientists.

Studies on women in professions have produced the concept of 'tokenism' which refers to the situation of being in a minority in male dominated professions. Women in academic science are a minority. Thus an attempt was made to examine whether respondents suffer due to tokenism. It is found that a token situation has an impact on the women academic scientists and a critical mass of women is desirable in science.

However, stereotypes about roles of men and women are not likely to change merely with an increase in their numbers. There are strong social values operating against women in science at all levels. Patrifocal values affect the condition of women in the family as well as in the workplace. These values are reflected in the stereotypes. The stereotypes about the roles of men and women have a powerful impact on the conditions in which women scientists work. Therefore it is necessary to include both workplace and family in the study of women academic scientists. The condition of such women scientists is dependent on the interaction between organisation of work and the institution of family, and, in turn affects both.

7.4 Methodology

To study the problems faced by women in scientific professions, four elite academic institutes from North India were chosen. They are IIT Kharagpur, IIT Delhi, University of Roorkee, and Jadavpur University. These institutes are known for their excellence in academic science and for giving due recognition to merit and talent. Since women faculty in science and engineering are few in number, all women faculty involved in teaching and research in science and engineering in these institutes were selected for

the study. At JU, there are 45 women faculty but only those with Ph.D. degree were contacted. Including the entire women faculty would have given disproportionate representation to women faculty at JU. The total sample size is 82. Data were collected using triangulation, that is, a combination of questionnaire, interview schedule, and unobtrusive methods. Questionnaires and interviews were used to collect data from all the respondents. Both questionnaires and interviews were used for 72 women faculty members. It was felt that while questionnaires help in obtaining general facts more objectively, the semi-structured interviews provide greater insights into the subject. Data have been analysed mainly through descriptive statistics such as frequencies, percentages, means, and standard deviations. Multivariate analysis was done by using the SPSS package.

7.5 Major Findings

The respondents, in general, belong to the upper caste, middle class Hindu background. Their educational achievements are considerably higher compared to their parents, indicating a high degree of social mobility. To a large extent their achievements are due to the encouragement they received at home that allowed them to pursue higher education and to make independent decisions. It is notable that for about 39% of the respondents career in academic science began after marriage. For such respondents in particular, and others in general, help of the spouse has been crucial in building up a career. Independence in decision making, the role of the spouse, and decline in age and academic hypergamy represent processes of change in patrifocal norms. Such changes in traditional norms follow with higher education among women. However, this process of change is not smooth. There are some cases where respondents had to settle for pure

science or mathematics and were discouraged from pursuing engineering disciplines since engineering is not found 'suitable' for women. The pressures of a joint family and the burden of managing both home and career fall disproportionately on women.

The study reveals problems and experiences of women academic scientists, which have a definite relation to the gender bias in the work environment and in society in general. This gender bias starts from the beginning but becomes more common when women pursue science and mathematics as students. Society and school underplay the achievements of women in science. They are discouraged by the academic institutions from pursuing certain branches of engineering such as mining and mechanical engineering. In admission as an undergraduate student or in appointment as a faculty, a feeling is often expressed that women take away a man's seat or job.

Science and its practice were idealised by Merton as a 'universalistic' system that is based on the principles of justice and equality and rewards merit. However, there is hierarchy in science. The paradigm of Western science is 'central' to this hierarchy and it dominates over the science practised in the 'peripheral' nations (that is, the less developed nations). Hierarchy operates within the countries also. Scientists from elite institutes are favoured in terms of funding for projects and awards. Most respondents felt that the system of rewards in science is not necessarily merit-based. Hard work and talent are not sufficient for rising in a career. Visibility and contacts with those in important positions matter a great deal. Women scientists suffer from a lack of contacts and visibility due to a lack of informal interactions.

'Indeterminate' and tacit elements are involved in the rule-bound aspects of the education system. A woman has to be better than a man to be granted a faculty position.

The gender-related issues are raised in the interview committees for appointments and promotions directly or indirectly. Selection committees often question the commitment of a woman candidate towards her job. Women faculty members face discrimination in the assignment of funds for international conferences and in obtaining projects. In the institutions and departments, which have a strong tradition of hierarchy, heads of the departments have often vitiated the atmosphere for women due to their biases and prejudices. Often senior men faculty does not treat women faculty as equals. Traditional engineering branches such as electrical and civil engineering (and in some institutes physics and chemistry) have been highly male-dominated with women entering the scene only in the 1990s. Women faculty in such departments face stereotypes about women's roles and it takes considerable time and effort to prove their talent. However, according to the respondents, the younger men faculty shows greater gender sensitivity and empathy towards women colleagues.

Women are almost absent at the higher levels of administration in the institutes. This implies that they lack power to influence decisions and men run the system. As a result, the system is oblivious to the special needs of women such as security and separate toilet facilities. Certain official rules have implications for women faculty which have not been given any attention.

Women faculty form only about 7% the total faculty in science and engineering. Thus, there is a lack of a critical mass. This creates a situation of 'tokenism'. Being few in numbers, women are more noticeable and their failings get immediately noticed. They are often excluded from informal socialisation. Men faculty interacts more among themselves and their jokes might even hint that a woman faculty should leave an informal

grouping. For women, informal interaction with men colleagues is problematic due to social stereotypes that segregate men and women. Participation of women faculty in informal activities of the campus is also restricted mainly due to time constraints.

Exclusion from informal interaction has serious career consequences. It is a common practice that the names of members of administrative committees are decided over an 'informal chat' and information regarding new research, resources, seminars and conferences, and changes in organisational goals and policies, are exchanged informally. Women faculty tend to miss out on such information due to a lack of informal interaction. Women also tend to travel less due to gender roles and security problems which affects their participation in conferences and seminars. As a consequence they usually lack contacts, are less visible, and their work may not get recognition as easily as a person who is highly mobile, has contacts, and is visible to the core set in his field.

Within the institute, the clerical staff, though courteous, is usually less willing to take orders from a woman than from a man. Women faculty usually enjoy their interaction with students. However, some respondents reported that male M.Tech. and Ph.D. students do not prefer a woman adviser due their prejudices such as, believing that a woman faculty is not competent enough or she will not be able to devote sufficient time to her work. Female students often choose woman faculty as their adviser. About 36% of the respondents enjoyed teaching more than research and about 40% enjoyed both. However, teaching does not bring any tangible rewards. As scientists, their efforts are likely to be underestimated and their professional competence is questioned. This is especially true for the initial stages of the career of women academic scientists. As a result, they have to work much harder than men in order to prove their capabilities.

The attempt to work hard for recognition puts a strain on women faculty. Due to a lack of informal interaction and mobility, women work in relative isolation. Patrifocal values demand that women remain submissive. They may face condescending behaviour from men colleagues and may be excluded from certain tasks such as being given the charge of some engineering section that has been so far run by men, and from the field work. These factors contribute to stress among women academic scientists.

The problems related to workplace are compounded by those related to family. Respondents agreed that marriage and motherhood affect career. However, since Indian social norms consider marriage and motherhood as a woman's '*dharma*' (sacred duty), women academic scientists consider success futile if career and family cannot be balanced. Strong family values coupled with the value of work bring about several types of responses. A woman may reduce her leisure time and manage her time efficiently; she may attempt to accommodate her family more than her career which leads to compromise with career and lowering of ambitions; or she may fail to do justice to either career or family and her physical and mental health may suffer in the process. Some respondents remained single due their perception that they will not be able to manage both career and family. Those respondents who are professionally successful also agreed that 'success' involves striking a balance between family and career. This attempt at balance puts a dual burden on a woman. As a matter of fact, when combined with the strain in the work environment, a triple burden is created. The major findings of this study are summarised in the Figure 7.1.

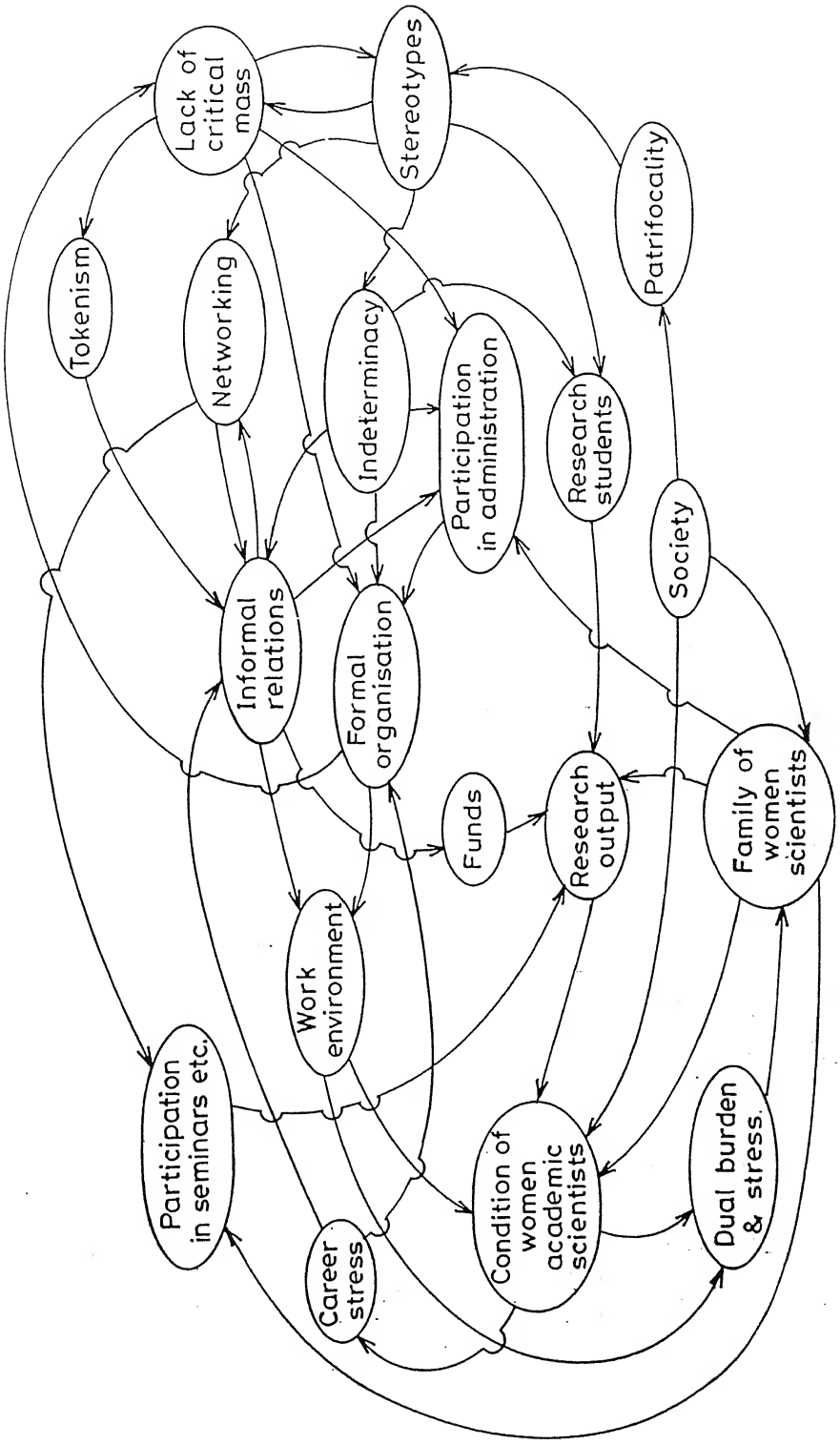

Figure 7.1 : Social and Organisational Factors Influencing Women Academic Scientists

Figure 7.1 shows various influences on women academic scientists that lead to a dual burden and career stress. The stress of the work and social environment, in turn, has an impact on the family and the organisation of formal and informal relations at work. The impact of science on the family is felt in terms of alienation of relatives, management of time and cutting down on leisure. Due to competing demands, women academic scientists tend to minimise their time on informal activities in the workplace. This, in turn, reinforces the perceptions about traditional gender roles.

Thus, findings of this study support the theory of 'tokenism'. The study also shows that attaining a critical mass of women faculty members is not enough. Patrifocal attitudes and stereotypes within the workplace, the family, and society at large influence the lives of women academic scientists. Indeterminate and tacit elements involved in the practice of this profession places women academic scientists at a disadvantage. In general, the study shows the importance of the concepts of indeterminacy and tokenism, and lends a general support to feminist theory.

7.6 Implications for Intervention

An increase in the number of women faculty could help in improving the work environment. However, quota systems in appointments and promotions may not be the best solution for attaining critical mass since it may perpetuate the differences and strengthen prejudices. Experience with 'reservations' (caste based quotas) has shown that they often lead to a compromise of merit. Thus women candidates who are not seen as meritorious enough to be selected in an open competition may be chosen if a quota system is implemented. This is undesirable for the growth of science. However,

preferences or encouragement of women faculty for participation in administration will not involve a compromise of merit. Such reservations may go a long way in 'empowering' women, giving them greater exposure and building up contacts. This will also help in making the system more balanced and gender sensitive and will help in recognising the needs of women.

Long term solutions have to be found if women's talent has to be harnessed properly. There is a need to recognise women as equal partners in the development of the country. Unless conscious efforts are made to raise the ratio of women in science and engineering, their proportion will continue to be low and a huge amount of nascent potential will remain unrecognised. Attitudes of the families that give greater importance to the career of a boy than a girl will take a long time to change. However, gendered environments in schools and institutions can be changed. For instance, bright girl students should be given equal encouragement at the school level. Since parents are often unwilling to spend money on expensive coaching for girls, coaching or tuition at subsidised rates for meritorious women candidates to compete in national exams of science and engineering should be introduced. The problem of childcare in the institutes can be reduced through good childcare facilities. It is important to recognise that childcare is not a woman's problem alone. It is a joint responsibility of the family and society.

It is essential for women faculty to form groups to solve their mutual problems and to remove the disadvantages arising out of a lack of contacts and informal interactions. Such groups will also enable women faculty to act in a united manner

against any discrimination. If the senior women faculty act as their mentors, it might help in building careers of younger women scientists.

Above all there is a need for a change in attitudes. This study shows that change has started occurring. Some change can be noticed in terms of the role of the spouse. About two-thirds of all respondents get help from their spouse in domestic or professional matters. The husband's support has been vital in the success of many woman scientists. Change is also seen by the respondents in the attitude of some of the younger men faculty members. The latter are seen to have a broader outlook than some of the senior men faculty.

7.7 Limitations of the Study and Issues for Future Research

It is important to point out limitations of the study and to suggest future research issues. Since this work was done as a part of the doctoral programme, women faculty members at only four institutes could be studied. Also, since this work is spread over four institutes, it lacks an in-depth analysis of any single institute through the methods of rigorous observation and multiple (repeated) interviews. For this reason, detailed case studies could not be developed.

One of the major limitations of this study is that it does not compare and contrast perceptions of women faculty with those of the men faculty. It is also important to study the men's perspective about the institute and women's issues in science and engineering. Such an analysis would help in clarifying the issues related to the work environment. Another limitation of this study has been the insufficient attention paid to the impact of science on the lives of women scientists such as its impact on their religiosity, on children

and elders in the family. These aspects would form an interesting subject for future research.

7.8 Conclusion

In sum, there is a need to realise that women's experiences are dissimilar to men's experiences even in the institutes of higher learning and in the profession of science, which is expected to be fair and just. There are biases and stereotypes that affect the work environment of women academic scientists and cause stress. The domestic role and work stress affect the careers of women. Most women academic scientists are not able to utilise their potential fully. As a result such women are at a lower position on the ladder of success than they could have been if the institution of science had not been gendered. They feel that they would have been at a higher position if they were male. This feeling is particularly marked among those who are lecturers and assistant professors. There is a need to make an effort to find solutions to such problems if the potential of women scientists is to be fully utilised and if more women are to be encouraged to take up this profession.

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APPENDIX A

Questionnaire
(Confidential)

The following questionnaire has been framed with a view to gather information on women in science for the research purpose. This information will be kept confidential and will be used for research alone.

I Biographical Details

1. Date of birth:..... Age (in years): .....
2. Religion: (a) Hindu (b) Muslim (c) Christian (d) Sikh (e) Others (specify):.....
3. Caste:
   Category:
   (i) General
   (ii) O.B.C.
   (iii)S.C./ S.T.
4. Place of birth: .....

5. Place where the respondent spent most of her life:

   City/Town: .....

   District:.....

   State:.....

6. Educational Qualifications:

Degree/Certificate	Name of the Institution	City/State	Year	Medium of Instruction	Subject / Area of specialization
High School					
Intermediate					
B.Sc./B.Tech.					
M.Sc./M.Tech.					
Ph.D.					

7. Mother's education: .....

8. Mother's occupation: .....

9. Father's education: .....

10. Father's occupation: .....

11. Marital status: Married / Single / Divorced / Separated / Widow

12. If married/divorced/separated/widow:
    a. Husband's education: .....
    b. Husband's occupation: .....
    c. Husband's place of work: .....
    d. Husband's income: .....
    e. Your age at marriage: .....
    f. Your husband's age at marriage: .....
    g. No. of children:
       Total: .....
       Male: .....
       Female: ....

13.
    a. No. of siblings:
       Brothers:..... ; Sisters:.....
    b. Siblings' education:

	Brothers		Sisters	
	Age	Education	Age	Education
1.				
2.				
3.				

14. Year of joining this institute: .....

15. Your designation when you joined: .....
    and now: .....

16. Your income (basic): .....

17. The nature of family in which:
    a. You were brought up: Joint/Nuclear
    b. You stay now: Joint/Nuclear

18. Do you have any close woman relative in science? Yes/No
If yes, what is the your relationship with them?

1.

2.

Did she influence you? Yes/No
If yes, how?

19. Do you have any close male relative(s) in science? Yes/No
If yes, what is your relationship with them?

1.

2.

Have they influenced you to go for science and technology? Yes/No
If yes, how?

20. Do you participate in seminars, conferences and workshops? Yes/No
If yes, how many times did you attend in the last three years in India and Abroad

	India	abroad
Seminars		
Conferences		
Workshops		

No. of papers presented in:
national conferences:.....and international conferences.....

21. Number of publications in journals (in the last five years):.....
Number of books published:.....
Number of other technical reports published in the last five years:.....

II.

1. Please tick in the column most appropriate:
   (1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	Scientists in India lack new ideas for research					
b	Scientists in India borrow ideas mostly from the West					
c	Peer review system in the Indian journals is not as rigorous as in the Western journals					
d	There is little/no crossflow of information from the research sector to industrial sector					
e	There is a paucity of public funding of R&D					
f	Government policies are not designed to promote R&D in industry					

2.

a. Given below are the traits required to succeed in science. How much do you agree with them? Please tick in the appropriate column.
   (1 = strongly agree 2 = agree3 = partly agree 4 = disagree 5 = strongly disagree)

	Item	1	2	3	4	5
a	Hard work					
b	Sharp intellect					
c	Competitive spirit					
d	Adaptability/flexible approach					
e	Contacts					
f	Creativity					
g	Foreign degree					
h	Ability to bring funds					
i	Ability to attract students for research					
j	Good interpersonal relations					
k	Communication skills					

b. Please rank (1, 2, 3,...) these traits in the order of their importance for success in science

	Item	Rank
a	hard work	
b	sharp intellect	
c	competitive spirit	
d	adaptability/flexible approach	
e	contacts	
f	creativity	
g	foreign degree	
h	ability to bring funds	
i	ability to attract students for research	
j	Good interpersonal relations	
k	Communication skills	

3. Society has different perceptions about the qualities of men and women. For example, women are seen to put in more hard work than men. Given below are the traits required to succeed in science. *Tick in the most appropriate column.*
(1. Women are seen to possess this trait in particular 2. None are seen to possess this trait in particular 3. Men are seen to possess this trait in particular).

		1	2	3
a	Hard work			
b	Sharp intellect			
c	Competitive spirit			
d	Adaptability/flexible approach			
e	Contacts			
f	Creativity			
g	Ability to bring funds			
h	Ability to attract students for research			
i	Good interpersonal relations			
j	Communication skills			

4. Do you agree with the following? Tick in the appropriate column.

	Statement	Yes	No
a	Teaching undergraduate courses keeps up motivation in research		
b	It is essential to keep up to date with researches in one's field so that one can impart latest information to the students.		
c	In remaining up to date in his professional line, a faculty improves his teaching skills.		
d	Research and teaching are complementary to each other.		
e	Teaching post-graduate courses keeps up motivation in research		

5. Please tick in the appropriate column.
(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	Success in scientific research is not always in proportion to merit					
b	Contacts are highly desirable for success					
c	There is a bias against women in obtaining rewards					
d	Women scientists are less successful because they lack contacts and networks					
e	Women scientists are not treated at par with men scientists in:					
	i. obtaining projects					
	ii. getting papers published					
	iii in obtaining awards					
f	Women have to work harder than men in order to prove themselves.					
g	Women are less familiar with the ways and means to achieve success in science than men					

6. How much do you agree with the following:
(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	The teaching load of women is higher than those of men which makes their research suffer					
b	Women scientists lack women collaborators					
c	It is difficult for women to collaborate with the men scientists					
d	Women scientists lack informal contacts with scientists					

7.

a. How useful are conferences and seminars?
(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	They help in increasing contacts and networks					
b	They are useful in bringing new ideas for research					
c	They bring the work of the less well known scientists in limelight					
d	They are very useful for women scientists in particular					

7.

b. How useful is participation in administration and consultancy?
(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	Administrative work hampers research					
b	Participation of more women in administration will make the administration more sensitive to women's needs					
c	Consultancy hampers research					

III. Following are some questions on the nature of occupational environment.

8. Do you face such problems in the departmental meetings?
(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	Group members are not willing to hear women					
b	Women have to speak louder and harder than others					
c	Women's point of view is not given due importance					

9. What is the availability of the following for men and women?
(1 = easily available 2 = not so easily available 3 = not available)

	Item	For Men			For Women		
		1	2	3	1	2	3
a	Laboratory equipment						
b	Materials						
c	Institutional funds						
d	Separate common rooms						
e	Classrooms for extra class						
f	Teaching aids						
g	Computer and the related state-of-the art technology						
h	Cooperation of the staff						
i	Cooperation of the colleagues						
j	Cooperation of the students						
k	Contacts with persons of subordinate ranks in different fields, within the institute						
l	Contacts with successful professionals in the same area outside the institute						
m	Ability to move from one place to another						
n	Contacts with persons of superior/equal ranks in different fields within the institute						
o	Contacts with persons of subordinate ranks in different fields outside the institute						
p	Contacts with persons of superior/equal ranks outside the institute						

10. How important the following items are to women scientists? To what extent are they available to women scientists?

	Item	Very Important	Important	Not Important	Do they exist? *			
					1	2	3	4
a	Separate common room							
b	Women mentors							
c	Women colleagues							
d	Contacts outside the organisation							
e	Geographic mobility							
f	Informal network with scientists							
g	Institutional childcare facilities							

(* 1 = yes 2 = in large measure 3 = in small measure 4 = no)

11. Below are some questions on the work culture in your organisation. Please tick in the appropriate column.
(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	Research is appreciated more than teaching					
b	Teaching is emphasised more than research					
c	Competition is more than cooperation					
d	Great deal of cooperation exists among the people in the same research area					
e	Many scientists come to the office on the weekends or work till late hours					
f	Women scientists are treated like any other scientist in the department					

IV.

12.

a. What is the level of participation of the men and the women scientists in the following?
(1 = very high 2 = high 3 = medium 4 = low 5 = none)

		Men					Women				
		1	2	3	4	5	1	2	3	4	5
a	Sports										
b	Hostel activities										
c	Activities of cultural and religious associations										
d	Movies shown by film societies, clubs, etc. on the campus										
e	Faculty/staff club activities										
f	Social service for relief programmes organised by the institute from time to time										
g	Tea lounge in the institute										

b. How much do you agree with the following:
1. Participation in the above activities provides visibility.
strongly agree agree partly agree disagree strongly disagree
2. Such activities help in building up informal contacts.
strongly agree agree partly agree disagree strongly disagree
3. Such activities can often lead to the formation of cliques.
strongly agree agree partly agree disagree strongly disagree

4. These informal contacts help in providing information which could be useful in career advancement.
   strongly agree agree partly agree disagree strongly disagree
5. Women lack contacts partly because of inability to participate in them.
   strongly agree agree partly agree disagree strongly disagree

13

a. In interacting with men scientists, formally or informally do you get the feeling that they think about the women scientists in the following manner:
(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	They feel that women scientists are different from 'normal' women ('normal' women being those who are seen to be involved more in family life than in career)					
b	They treat women scientists as any other scientist and are insensitive to their identity as women					
c	They treat women scientists as any other woman and not like a professional colleague					
d	They treat women scientists both as woman and scientist					

b. In your opinion what is the perception of men scientists about the women scientists in your institute? Tick the appropriate phrase below each statement.

a. Men scientists feel that women do not conduct research of a good quality as compared to men.
   strongly agree agree partly agree disagree strongly disagree
b. Men scientists feel that women do not make good administrators as compared to men.
   strongly agree agree partly agree disagree strongly disagree
c. Men scientists feel that women are better teachers as compared to men.
   strongly agree agree partly agree disagree strongly disagree
d. Men scientists feel that women are too emotional as compared to men.
   strongly agree agree partly agree disagree strongly disagree
e. Men scientists feel that women are troublemakers as compared to men.
   strongly agree agree partly agree disagree strongly disagree
f. Men scientists feel that women are more honest and sincere as compared to men.
   strongly agree agree partly agree disagree strongly disagree
g. Men scientists feel that women are more dedicated to research as compared to men.
   strongly agree agree partly agree disagree strongly disagree

14.

a. Due to the prevalent stereotypes, students may have fixed opinion about the performance of the women scientists. What is your experience? Tick the most appropriate statement:
   1. Students underestimate the performance of women scientists.
   2. Students overestimate the performance of women scientists
   3. Neither
   4. Cannot say

b. If there is a good woman scientist, will her effort be overestimated by her colleagues because she is different or will her effort be still underestimated? Tick the appropriate phrase:
   1. Overestimated
   2. Underestimated
   3. Correctly evaluated
   4. Cannot say

15. In your opinion, what is the perception of the clerical staff about the female scientists? Tick the appropriate phrase below each statement.

   a. Requests by the women scientists can be ignored or taken lightly.
   strongly agree *agree* *partly agree* *disagree* *strongly disagree*
   b. Women scientists are troublemakers.
   strongly agree *agree* *partly agree* *disagree* *strongly disagree*

16. Do you agree that the system judges more by the stereotype than ability or that this is not the case?
   Stereotype judgement/Judgement by ability/Cannot say

V.

17. Who took the following decisions related to your career? Please tick in the appropriate column.

		Father	Mother	Other close relative	Self	Husband	Others (specify)
a	Choice of science or engineering as a subject in school						
b	The branch of science or engineering to be selected						
c	The institute to be joined: i. for B.Sc./B.Tech.						
	ii. for M.Sc./M.Tech						
	iii. for Ph.D.						
d	Taking up job as an academic scientist						
e	To continue working after marriage						
f	Selection of institute to work before marriage						
g	Selection of institute to work after marriage						

18.

a. Do you agree that women often receive the following messages from the social environment:

(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	Many people think that women cannot be successful in science/math					
b	Many people think that to do science and engineering is to be less of a woman					
c	Many people think that a woman has less analytical ability than men					
d	Many people think that inability to solve a problem is ascribed to the quality of being a woman					

b. Do you agree with the statements given below? Tick in the appropriate column.

(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	Women cannot be successful in science/mathematics					
b	To do science and engineering is to be less of a woman					
c	A woman has less analytical ability than men					
d	Inability to solve a problem is due to the quality of being a woman					

19.

a. Please tick the appropriate phrase after each statement.

i Marriage affects career because of migration from earlier place of work to another.

strongly agree agree partly agree disagree strongly disagree

ii. Marriage affects career because of added social obligations.

strongly agree agree partly agree disagree strongly disagree

iii Motherhood affects scientific productivity.

strongly agree agree partly agree disagree strongly disagree

iv Motherhood leads to decline in job commitment.

strongly agree agree partly agree disagree strongly disagree

iv Motherhood leads to decline in job involvement.

strongly agree agree partly agree disagree strongly disagree

20. How do you feel about your job? Tick in the column most appropriate.
(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

		1	2	3	4	5
a	I find real enjoyment in my work					
b	I feel fairly well satisfied with my job					
c	Most days I am enthusiastic about my work					
d	I feel that my job is not more interesting than others I could get					
e	I am disappointed that I ever took up this profession					
f	Most of the time I have to force myself to go to work					

21. How much involved do you feel in your profession? Tick in the column most appropriate.
(1 = strongly agree 2 = agree 3 = partly agree 4 = disagree 5 = strongly disagree)

	Statement	1	2	3	4	5
a	Most of my interests are centered around my job					
b	Most of my personal life goals are job oriented					
c	To me, my job is only a small part of who I am					
d	Usually I feel detached from my job					
e	I live, eat and breathe my job					
f	I have very strong ties with my job which would be very difficult to break					

22. Please tick the appropriate phrase after each statement. These statements reflect some possible feelings about academic science as career. How often do you feel them?
(1 = always 2 = often 3 = sometimes 4 = rarely 5 = never)

	Statement	1	2	3	4	5
a	My job is too demanding to really enjoy it					
b	Pressures of being a homemaker and a scientist makes me feel tired physically					
c	Pressures of being a homemaker and a scientist makes me feel tired emotionally					
d	Pressures of being a homemaker and a scientist makes me feel tired mentally					
e	Weariness comes from bearing pressures related more to the job than other aspects of life					
f	Male colleagues tend to form their own groups, isolating women scientists					
g	There is a dearth of persons with whom I could discuss professional matters or communicate research ideas					
h	I feel that I have little control over my life and its events					
i	I feel that life has become mechanical					
j	I feel powerless to reduce the pressures of scientific practice					
k	I feel that I do not quite belong in science					

Name:

Department:

Institute:

APPENDIX B

Interview Schedule
(Confidential)

I. Nature of science and academics:

1. What qualities should a piece of research have, so as to be assessed as a 'good quality research'?

   a.

   b.

   c.

   d.

   e.

2. What do you think is the quality of scientific research being conducted in the institute in your field of study?

   a. as good as anywhere

   b. mediocre

   c. poor

3a. What do you think is the quality of scientific research being conducted in India (in your field)?

   a. as good as anywhere

   b. mediocre

   c. poor

3b. Could the quality of research be improved? Yes/No
If yes, how?

In the institute:

a.

b.

c.

In India:

a.

b.

c.

4a. Should research be conducted for pure/applied/both purposes?

4b. Is research conducted for 'pure' research or for application purposes-
In your institute:

Pure Applied Both Can't say

In India:

Pure Applied Both Can't say

5. What are the essential qualities required for attaining success in science?

	Social	Organisational	Personal
a			
b			
c			
d			
e			

6a. Faculty members in science/technology institutes are supposed to take up teaching, research and corporate activities. Which activities are you involved in? Teaching/Research/Others (specify)?

b. Are you also involved in committee work, consultancy, social work or any other activity? Yes/No

c. Among all the activities performed by you, which activity do you enjoy most? (rank in order)
Teaching/Research/Consultancy/Administration/Social work/Any other (specify)

d. What is the time devoted to: (arrange in terms of time spent in descending order)

Teaching

Research

Consultancy

Social work

Others (specify)

e. Do efforts made in undergraduate teaching help in attaining success in scientific career?

	Yes, how?	No, why not?
1.		
2.		
3.		

f. Do efforts made in post-graduate teaching help in attaining success in scientific career?

	Yes, how?	No, why not?
1.		
2.		
3.		

7. What are the advantages/disadvantages to women scientists in India compared to those in the West?

	Advantages	Disadvantages
a		
b		
c		
d		

8a. Did you have a role model at any point of time? Yes/No
If yes, who?

When?

Why?

1.

2.

3.

8b. Was there a woman scientist in your department when you first joined the institute? Yes/No

If yes, in what way did you gain from her experience?

1.

2.

3.

8c. Did you face any problem in an overwhelmingly male environment? Yes/No
If yes, what type of problems did you face?

1.

2.

3.

9. We find that there are more women in pure sciences than in engineering? What, in your opinion are the reasons?

1.

2.

3.

10a. What do you want to achieve in life? (name, fame, money, liberation, social change, etc.)

1.

2.

3.

10b. How will scientific career help in that?

1.

2.

3.

11a. What were your expectations from the institute when you first joined?

1.

2.

3.

11b. Have they been fulfilled? Yes/No
If yes, how?

1.

2.

3.

If no, why not?

1.

2.

II. The nature of occupational environment: Formal structure

12. If the bio-data of a man and a woman candidate are same, will the institute prefer one over the other in appointment/promotion? Yes/No

If yes, what?

In appointment: Male/female/none in particular/depends on the constitution of the committee (which type of committee)? Why?

In promotion: Male/female/none in particular/depends on the constitution of the committee (which type of committee)? Why?

13a. Are there some other factors also which adversely affect the appointment or promotions of women scientists? Yes/No

b. If yes, what?

For appointment:

1.

2.

3.

For promotion:

1.

2.

3.

14. Are there some organisational policies or unwritten rules which indirectly affects women's work adversely or favourably (e.g., quotas, pregnancy rules, etc.)? Yes/No

    If yes, what are they?

    1.

    2.

    3.

15. Are research scholars (M.Tech./Ph.D. students) important to your research? Yes/No
    If yes, how?

    1.

    2.

    3.

16. Do you face any problem from your department in assignment of
    a. research scholars: Yes/No

       If yes, what?

       1.

       2.

       3.

    b. funds: Yes/No

       If yes, what?

       1.

       2.

       3.

    c. Do you face problems from any other source? Yes/No
       If yes, what?

d. Would you prefer men/women research student? Men/Women
Why?

17. Is there any difficulty/constraint for women, as compared to men, in obtaining funds for conferences and seminars from government and other donors? Yes/No

If yes, what?

1.

2.

3.

18a. Are there some unique problems or constraints faced by women scientists as women in your institute? Yes/No

b. If yes, what are they?

1.

2.

3.

c. Which is the most important problem?

19a. How many female administrators are there in your institute?

b. If few, why so?

1.

2.

3.

c. Have there been any female deans in last five years? Yes/No
If no, why?

1.

2.

d. Do you hold any administrative post in the institute? Yes/No

e. If no, would you take up an administrative position?

If yes, why? If no, why not?

f. If women do not accept administrative positions, does that affect their advancement in the institute? Yes/No

How?

III. The nature of occupational environment: Informal structure

20a. Do you think that since women scientists are very few, they are more noticeable and more carefully watched? Yes/No

b. If yes, do you feel uncomfortable with this? Yes/No/Got used to it

c. If yes, in what way?

d. Is there any other impact of such visibility on you? Yes/No

e. If yes, what?

1.

2.

3.

21. Is there any impact of smallness of number of women in faculty on their relationship with colleagues, staff and administrators? Yes/No

If yes, what?
with colleagues:

1.

2.

with staff:

1.

2.

3.

with administrators:

1.

2.

3.

22. At what informal forums do you interact with your:

	Colleagues	Staff	Administrators
1			
2			
3			

23. Do you think that your participation at informal forums is less, more or similar to that of men faculty. Less/Equal/More

If less, in which forums is it less?

1.

2.

3.

Why? (probe)

1.

2.

3.

24. Do you agree that participation in informal groups and activities may have some bearing on one's career? Yes/No
Do women generally lack such participation? Yes/No/Sometimes
If yes, does it have any impact on their career? How?

1.

2.

3.

25a. Are there some powerful cliques in your department? Yes/No/not aware of any.
Do you form part of any of it? Yes/No
Is it important to join a clique? Yes/No
Do women form part of them usually? Yes/No/Sometimes

b. Any other kind of groupism existing in the department?

1.

2.

3.

c. Do such groups influence important decisions in the department?

26. Have you come across the following in your interaction with the men scientists, staff or students:

a. Questioning of your professional competence and being treated merely as a woman, regardless of talent. Yes/No
If yes, could you give an example?

b. Expectation of stereotype roles from women (e.g., little sister for elderly colleagues, mother like figure for students). Yes/No
If yes, could you give an example of this?

c. Use of sexist comments/language. Yes/No (e.g. indecent letters, e-mails)
If yes, could you give an example of this? (probe)

d. Addressed by students normally as Miss/Mrs./Sir/Madam/Professor.

e. Need for you to maintain distance and avoiding free mixing. Yes/No
If yes, with whom?

Why?

f. Sexual harassment at the workplace. Yes/No
If yes, could you give an example of this?

How do women scientists defy it?

1.

2.

3.

27a. Do you think that contacts and networks help in one's career? Yes/No
If yes, how?

1.

2.

3.

27b. Do you think that women scientists lack contacts and networks? Yes/No
If yes, why?

1.

2.

3.

How does it affect their career?

28a. Do you work in collaboration with other scientists? Yes/No
If yes, are they men/women?
Are they within or outside the institute?

1.

2.

3.

28b. Are you satisfied with your collaborations? Yes/No
If no, why?

1.

2.

3.

29a. Are you comfortable in travelling out-of-station alone? Yes/No
b. Do women scientists travel less than men scientists? Yes/No
c. If yes, why?

d. Does it affect their career in terms of obtaining projects, attending seminars/conferences, etc. Yes/No

e. How else does it affect one's career?

30a. What other problems/stereotypes do women scientists face in this profession due to gender?

1.

2.

3.

30b. Imagine there is a ladder of success. On its first step is the least successful scientist and on the tenth step is the most successful one. Where will you place yourself?

Where do you think you would have been if you were a male?

31a. Would you recommend this profession for your daughter? Yes/No
b. If yes, why?

1.

2.

3.

c. If no, why not?

1.

2.

3.

IV. Family Structure

32a. Who made major decisions at various stages of your career? (Probe)
1.

2.

3.

4.

5.

32b. Did your parents have different expectations from you and your sisters compared to your brother(s)? Yes/No
If yes, what?

From brothers:

1.

2.

3.

From you and your sisters:

1.

2.

3.

32c. Did you face any problem as a student because of being a female? Yes/No
If yes, what?

33. Are you married? Yes/No
If yes,
a. Was your marriage an arranged one? Yes/No
If yes, did they have any problems in finding groom? Yes/No
If yes, what?

b. Was the marriage in accordance with traditional customs? Yes/No
If no:
1. Are there some unique social problems faced by you? Yes/No
What?
2. Does it affect your formal or informal interactions within the institute? Yes/No
How?

3. Does it affect your career? Yes/No
How?

4. Would you prefer arranged or non-arranged marriages?

5. Did your parents attempt to find a groom? Yes/No
If yes, was there a problem in it? Yes/No
What?

34. Did your parents foresee plus points of your high education? Yes/No
If yes, what?

1.

2.

3.

35. Did they foresee some negative points also? Yes/No
If yes, what?

1.

2.

3.

36a. Do you have some help in performing household tasks? Yes/No
If yes, who?

b. What kind of household tasks you cannot avoid?

1.

2.

3.

c. Does your husband help you in household chores? Yes/No
If yes, in what?

1.

2.

3.

37. Are there some customs of your community which women generally follow but you have stopped? Yes/No
If yes, which ones?

1.

2.

3.

Why stopped?

38. Do you feel that the women bear the dual burden of homemaking and job, or that there is no difference these days between tasks of men and women?

a. There is dual burden
b. There is no difference

If (a) how do you cope up with it?

39a. Has science and its practice contributed in some positive way to your life? Yes/No
If yes, how?

1.

2.

3.

b. Has science and its practice had some negative impact on your life? Yes/No
If yes, how?

1.

2.

3.

40a. Does culture of the state in which your institute is placed, influence the environment or work culture in your institute also? Yes/No
If yes, how

1.

2.

3.

b. Is there any impact of this on women scientists in particular? Yes/No
If yes, what?

1.

2.

3.

c. In community living, would women scientists identify more with the scientist, with the women on the campus or they feel that they are different from both?
Scientists/Women/Different/Can't say

V. Visualising change

41a. Do you think that increase in the number of women scientists will help in making the job environment more comfortable? Yes/No

b. Is there any childcare facility for women scientists? Yes/No

c. Do you think that organisation should provide childcare facilities for the women scientists as in some western countries? Yes/No

d. Do you think that any other institutional facility will help and encourage women to opt for this career? Yes/No
What?

e. Do you encourage women students in your class to go for a career in science? Yes/No
If yes, how?

1.

2.

3.

42. Do you think that change in some procedures or rules will encourage women to go for a science career? Yes/No

What are those?

1.

2.

3.

43a. Who do you think is a 'successful woman'?

b. Do you consider yourself a `successful woman'? Yes/No
If yes, why?

c. Are you linked with some organisation/scheme to encourage women in science? Yes/No
If yes, what are those?

1.

2.

3.

d. Would you favour special quotas or advising/mentoring programmes? Yes/No

e. Do you have some suggestions to encourage women in science?

1.

2.

3.

Name:

Department:

Institute:

APPENDIX C

सचिव
भारत सरकार
विज्ञान और प्रौद्योगिकी मंत्रालय
बायोटेक्नोलॉजी विभाग
ब्लाक–2, 7 वां तल, सी०जी०ओ० कम्पलेक्स
लोदी रोड, नई दिल्ली–110003
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF SCIENCE & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
Block-2 (7th Floor) CGO Complex
Lodi Road, New Delhi-110003

D.O.No.5149/SBT/98

September 17, 1998

Subject : **Colloquium on Biotechnology for Women : A vision for 21st Century.**

Dear Dr. [redacted],

The year 1998 has been declared as the International Year of Women. Number of celebrations, meetings, workshops etc. have been held to consider various aspects related to women's welfare.

The Department of Biotechnology has initiated a scheme entitled "Biotechnology based programmes for women". It has been recognised by the Expert Committee and a large number of distinguished women biotechnologists and biologists in the country that women in general have keen interest in pursuing biology as a profession. It is also fully recognised that the present age of "modern biology" has to offer in a significant way for developments in the next century. It would be the inputs of modern biology which would lead to a bio-industrial revolution. The areas of direct relevance to humankind, namely, agriculture, healthcare system, environment, industry etc. would largely benefit from advances in this field. It is, therefore, necessary that more and more women scientists and technologists are enthused and encouraged to take up bioscience as a career.

Accordingly, in this International Year of Women, in order to discuss various opportunities and challenges in this field and a perspective for the 21st Century the Department of Biotechnology is organising a one day colloquium on **November 7, 1998, at the National Institute of Immunology, Aruna Asaf Ali Road, New Delhi- 110 067.** The colloquium will be from 9.00 a.m. to 6.30 p.m., followed by a dinner at NII.

[redacted]

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INDIAN
INSTITUTE OF
TECHNOLOGY
[redacted]

APPENDIX D

भारतीय
प्रौद्योगिकी
संस्थान
[redacted]

EPARTMENT OF [redacted]

Date:

To
Shri P.V.Narsimha Rao
Hon'ble Prime Minister of India
3 Race Course Road-11
New Delhi

Respected Sir,

Equal rights for men and women have been granted by the constitution. The family planning programme further highlights this by denouncing the taboo against the female child. Unfortunately, the Central Govt. rules for extending the medical benefits to its woman employees are in contradiction to the stipulation of the constitution.

Husband and wife employed in the same Central Govt. organisation discharge their duties independently and absolutely in their personal capacities. . Facilities are to be provided treating them as individuals, not as spouse of one or the other. Accordingly, they should be allowed to claim medical benefits for her parents and other dependant., as may be allowed to a male employee of the Central Government. In the absence of this provision, it will be an uncomfortable decision on the part of an woman employee to get married last her parents will be deprived of the benefits they used to enjoy till she gets married.

It appears (the enclosed letter may be referred) that within the frame of the Central Govt. rule, provisions are not there to cover the above mentioned privileges. As I understand either of the parents will get the benefit and other one will suffer. In the prevalent situation, the sufferer will be the wife's parents. The family planning programme also implicitly assures looking after the aged parents by son and daughter alike.

In view of the above, the present medical benefit rule for Central Govt. employee should be thoroughly revised and the woman employee should be granted an individual status with full privileges. She should have the right to include her parents and any other member dependent on her, as admissible under the rule.

Contd.....2.

PHONE : (03222) 2221 to 2224 . Gram : Technology Kharagpur , Telex : 06401-201 ITKG IN . Fax: 91- 3222 -2303

May, I, therefore request you to issue necessary instructions in full respect to the Constitution to remove the existing anomalies in the rules; so that an woman in India will stand in her own right.

Thanking you, with kind regards,

Sincerely yours,

Copy to: Shri Madhab Rao Scindia
Hon'ble Minister of
Human Resource Development
1, Race Course Road-11
New Delhi

[redacted] Institute of Technology

[redacted]

[redacted]

m e m o

With reference to her application dated 15.12.199[redacted] requesting to issue separate Medical Card in the name of herself and her husband, the undersigned is directed to inform Dr.(Ms.) [redacted], Associate Professor [redacted] Department that though the competent authority has considered her request sympathetically, it is regretted that her request could not be acceeded to as the Government of India rules on the subject as approved by the Board of Governors do not provide for the same. However, a specific reference has been made to the Ministry for a clarification.

In view of the above, she is requested to get a single medical Card either in her name or her husbend as per the GOI rules on the subject.

Clarification, if any, received from the Ministry will be followed with the approval of the competent authority.

[redacted]
Registrar

To
Dr.(Ms.) [redacted]
Associate Professor,
[redacted] Department

Through : Head of the Department,
[redacted]

[redacted]

Indian Institute of Technology
[redacted]

No, [redacted]

Dated: [redacted]

This has reference to her representation dated 31 October, 199[redacted] and the discussion with the undersigned of date.

2. Mrs [redacted], Associate Professor, [redacted] Department is informed that for the purpose of availing of medical facilities under GOI rules where both wife and husband working in the same organisation, either of them may prefer claim for self and eligible member of their family according to his/her status. She may kindly refer to Explanation(c) below Note 2 of 'Definition of Family' an extract of which is appended below :

> In case where both husband and wife are Central Government servants, they as well as eligible dependants, may be allowed to avail of the medical concessions according to his/her status. For this purpose, they should furnish to their respective authorities a joint declaration as to who will prefer the claim for reimbursement of medical expenses incurred on the medical attendance and treatment in respect of wife/husband and the children ...'.

3. However, it is informed that the matter raised by her was referred to the MHRD for clarification which is still awaited. In this connection, she may kindly refer to memos of even no. dated 17.1.9[redacted] and 24.10.9[redacted].

[redacted]
Registrar

To
Mrs [redacted]
Associate Professor,
Department of [redacted]
IIT [redacted]

Through: HOD, [redacted] Department, IIT [redacted].